REPORT RESUMES

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METAL FORMING AND FABRICATION CLUSTER--AN INVESTIGATION AND DEVELOPMENT OF THE CLUSTER CONCEPT AS A PROGRAM IN VOCATIONAL EDUCATION AT THE SECONDARY LEVEL.

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THIS COURSE OUTLINE ON METAL FORMING AND FABRICATION IS PART OF THE FINAL REPORT ON "CLUSTER CONCEPT" COURSES IN VOCATIONAL EDUCATION FOR SECONDARY EDUCATION (ED 010 301). EACH JOB ENTRY TASK WAS ANALYZED FOR HUMAN REQUIREMENTS (COMMUNICATION,MEASUREMENT, MATHEMATICS, SCIENCE, SKILLS, AND INFORMATION) NECESSARY TO PERFORMANCE OF THE TASK. THE TASK STATEMENTS FOR MACHINING, WELDING, SHEET METAL WORK, AND ASSEMBLY WERE WRITTEN IN BEHAVIORAL TERMS WHICH PROVIDE THE INSTRUCTOR WITH A DESCRIPTION OF WHAT THE STUDENT SHOULD BE ABLE TO DO AFTER HE HAS HAD THE LEARNING EXPERIENCE. INSTRUCTIONAL SEQUENCES WERE PROVIDED AT THE END OF THE TASK ANALYSIS SECTION TO AID THE TEACHER IN DEVELOPING LESSON PLANS, MATERIALS OF INSTRUCTION, AND VISUAL AIDS. (FOR OTHER COURSE OUTLINES SEE ED 010 302 AND ED 010 303.) (GC)

ED010304

FINAL REPORT

(One of Four Volumes)

AN INVESTIGATION AND DEVELOPMENT OF THE CLUSTER CONCEPT AS A PROGRAM IN VOCATIONAL EDUCATION AT THE SECONDARY SCHOOL LEVEL

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INTRODUCTION

The volume for the occupational cluster of Metal Forming and Fabrication is the result of the research procedures which are described in Part III of the final report volume. The research initially involved the identification of tasks which are required for entry into the occupations found in the Metal Forming and Fabrication Cluster. These tasks are classified into two categories:

Level I - Those tasks which are needed immediately upon job entry.

Level II- Those tasks which are not needed immediately for job entry into an occupation, but will be needed soon after entering the occupation.

Each job entry task was then analyzed with respect to the areas of human requirement (communication, measurement, mathematics, science, skills and information) which are necessary for the performance of the task. The task statements and the areas of human requirement are written in behavioral terms which provide the instructor with a description of what the student should be able to do after he has had the learning experience.

The areas of human requirement that are common to the occupations included in the Metal Forming and Fabrication Cluster have been determined and are identified in the task analysis section in the following manner:

Δ Common to all occupations

* Common to more than one occupation

ø Common within the occupation

A suggested instructional sequence for each task is provided for the teacher at the end of the task analysis section. The task is shown at the top of the page with the headings for the areas of human requirement listed below the task. Under each heading the behavioral statements have been arranged in a suggested instructional sequence. The arrangement provides the teacher with an instructional pattern that can also be used to develop lesson plans, materials of instruction and visual aids.

A course outline has been developed for each occupation in the Metal Forming and Fabrication Cluster. The outlines are based upon an analysis of the job entry tasks and the identification of common areas of human requirement.

JOB ENTRY TASKS

METAL FORMING AND FABRICATION

A list of tasks have been identified in this section of the report that are needed for entry into the occupations included in the metal forming and fabrication cluster. The job entry tasks for the cluster are classified into two categories:

Level I - those tasks which are needed immediately upon job entry.

Level II - those tasks which are not needed immediately for job entry into an occupation, but will be needed soon after entering the occupation.

LEVEL I JOB ENTRY TASKS

Machining

Task No.	Task Statements
1.	Turning stock on lathe to produce a faced surface.
2.	Countersinking (countersink and center drill) stock to produce a tapered hole for mounting stock between centers.
3.	Turning stock on lathe to produce a cylinderical shape to .001 of an inch.
4.	Turning stock on lathe to produce a shoulder to .001 of an inch.
5.	Drilling stock on lathe to produce a hole to .005 of an inch.
9.	Parting stock on lathe to produce a piece within 1/32 of an inch.
11.	Filing stock on lathe to produce a finished surface
12.	Machining stock on shaper to produce a flat surface.
13.	Machining stock on shaper to produce two parallel surfaces to .005 of an inch.
14.	Drilling stock on drill press to produce a hole to .005 of an inch.
16.	Spot facing a hole on drill press to produce a finished surface to .005 of an inch.
17.	Countersinking on drill press to produce a fastener receiver hole.
19.	Grinding stock on bench grinder to remove excess metal.
20.	Grinding drill bits on a bench grinder to shappen tools.
21.	Grinding stock on surface grinder to produce a flat surface.
22.	Grinding stock on surface grinder to produce two parallel surfaces to .001 of an inch.
25.	Machining stock on a horizontal milling machine to produce a flat surface.

26. Machining stock on a horizontal milling machine to produce parallel surfaces to .001 of an inch.

30. Machining stock on a vertical milling machine to produce a flat surface.

31. Machining stock on a vertical milling machine to produce two parallel surfaces to .001 of an inch.

Welding

1. Arc welding ferrous metals with A. C. welder to produce a horizontal butt joint.

2. Arc welding ferrous metals with A. C. welder to produce a horizontal lap joint.

3. Arc welding ferrous metals with A. C. welder to produce a horizontal outside corner joint.

4. Arc welding ferrous metals with A. C. welder to produce a horizontal inside corner joint.

5. Arc welding ferrous metals with A. C. welder to produce a horizontal tee joint.

6. Arc welding ferrous metals with A. C. welder to produce a vertical lap joint.

9. Arc welding ferrous metals with D. C. welder to produce a horizontal butt joint.

10. Arc welding ferrous metals with D. C. welder to produce a horizontal lap joint.

11. Arc welding ferrous metals with D. C. welder to produce a horizontal outside corner joint.

12. Arc welding ferrous metals with D. C. welder to produce a horizontal inside corner joint.

13. Arc welding ferrous metals with D. C. welder to produce a horizontal tee joint.

14. Arc welding ferrous metals with D. C. welder to produce a vertical lap joint.

17. Pad welding low areas on metal stock to renew stock to original height.

18. Gas welding ferrous metals stock to produce a horizontal butt joint.

19. Gas welding ferrous metals stock to produce a horizontal lap joint.

20. Gas welding ferrous metals stock to produce a horizontal outside corner joint.

21. Gas welding ferrous metals stock to produce a horizontal inside corner joint.

22. Gas welding ferrous metals stock to produce a horizontal tee joint.

23. Gas welding ferrous metals stock to produce a vertical lap joint.

24. Gas cutting ferrous carbon steels.

25. Brazing ferrous metals to produce a horizontal butt joint.

26. Brazing ferrous metals to produce a horizontal lap joint.

27. Brazing ferrous metals to produce a horizontal outside corner joint.

28. Brazing ferrous metals to produce a horizontal inside corner joint.

29. Brazing ferrous metals to produce a horizontal tee joint.

30. Brazing ferrous metals to produce a vertical lap joint.

Sheet Metal

1. Tracing templates on sheet metal for cutting, bending and joining sheet metal items.

2. Cutting sheet metal with hand tools to produce a straight cut within 1/32 of an inch.

4. Cutting sheet metal with hand tools to produce a circular cut within 1/32 of an inch.

6. Cutting sheet metal with hand tools to produce an irregular cut within 1/32 of an inch.

8. Cutting sheet metal with hand tools to produce a notched cut within 1/32 of an inch.

10. Cutting sheet metal to produce an interior cut within 1/32 of an inch.

12. Forming sheet metal crimping on a crimping machine.

13. Forming sheet metal beading on a beading machine.

20. Drilling sheet metal to produce a fastener receiver hole.

24. Fastening sheet metal parts with sheet metal screws to produce an assembly.

25. Bolting sheet metal parts to produce an assembly.

27. Joining sheet metal parts with seams.

Assembly

1. Adhering parts with adhesives using hand processes to produce a metal bonded assembly.

3. Fastening metal parts with screws to produce an assembly.

4. Bolting metal parts with screws to produce an assembly.

5. Riveting metal parts to produce an assembly.

6. Tightening metal fasteners with hand power tools.

9. Holding parts in clamping devices for assembly of details, sub-assemblies and assemblies.

12. Filing stock to produce a finished assembly to .001 of an inch.

13. Drilling holes in material with hand drill to produce a hole to .005 of an inch.

14. Drilling holes with a hand power drill to produce a hole to .005 of an inch.

17. Countersinking holes with hand tools to produce a fastener receiver hole.

18. Countersinking holes with power drill to produce a fastener receiver hole.

23. Checking dimensions of details with precision instruments for accurate assembly.

24. Checking dimensions of sub-assemblies and assemblies to produce accurate assemblies.

26. Stamping number and letters on metal stock for identification.

27. Hammering appropriate metal parts with various hammers.

LEVEL II JOB ENTRY TASKS

Machining

Task No.	Task Statements
6.	Reaming stock on lathe to produce a finished hole to .001 of an inch.
7.	Boring stock on lathe to produce an enlarged hole to .001 of an inch.
8.	Counterboring stock on lathe to produce a recessed hole to .005 of an inch.
10.	Necking stock on lathe to produce a necked shape to 1/32 of an inch.
15.	Reaming a hole on drill press to produce a finished hole to .001 of an inch.
18.	Counterboring stock on drill press to produce an enlarged hole to .005 of an inch.
23.	Grinding stock on surface grinder to produce two perpendicular surfaces to .001 of an inch.
24.	Grinding stock on surface grinder to produce an angular surface.
27.	Machining stock on a horizontal milling machine to produce two perpendicular surfaces to .001 of an inch.
28.	Machining stock on a horizontal milling machine to produce a shoulder to .001 of an inch.
29.	Machining stock on a horizontal milling machine to produce an angular surface.
32.	Machining stock on vertical milling machine to produce two perpendicular surfaces to .001 of an inch.
33.	Machining stock on vertical milling machine to produce a shoulder to .001 of an inch.

Welding

Task No.	Task Statements
7.	Arc welding pipe stock with D. C. welder to produce a butt joint while fixed.

8. Arc welding pipe stock with A. C. welder to produce butt joints while rolling.

15. Arc welding pipe stock with D. C. welder to produce butt joints while fixed.

16. Arc welding pipe stock with D. C. welder to produce butt joints while rolling.

31. Brazing non-ferrous metals to produce a horizontal butt joint.

32. Brazing non-ferrous metals to produce a horizontal lap joint.

33. Brazing non-ferrous metals to produce a horizontal outside corner joint.

34. Brazing non-ferrous metals to produce a horizontal inside corner joint.

35. Brazing non-ferrous metals to produce a horizontal tee joint.

36. Brazing non-ferrous metals to produce a vertical lap joint.

37. Inert gas welding ferrous metals to produce a horizontal butt joint.

38. Inert gas welding ferrous metals to produce a horizontal lap joint.

39. Inert gas welding ferrous metals to produce a horizontal outside corner joint.

40. Inert gas welding ferrous metals to produce a horizontal inside corner joint.

41. Inert gas welding ferrous metals to produce a horizontal tee joint.

42. Inert gas welding ferrous metals to produce a vertical lap joint.

43. Inert gas welding pipe stock to produce butt joints while rolling.

44. Inert gas welding pipe stock to produce butt joints while fixed.

45. Inert gas welding non-ferrous metals to produce a horizontal butt joint.

46. Inert gas welding non-ferrous metals to produce a horizontal lap joint.

47. Inert gas welding non-ferrous metals to produce a horizontal outside corner joint.

48. Inert gas welding non-ferrous metals to produce a horizontal inside corner joint.

49. Inert gas welding non-ferrous metals to produce a horizontal tee joint.

50. Inert gas welding non-ferrous metals to produce a vertical lap joint.

51. Inert gas welding non-ferrous pipe stock to produce butt joints while rolling.

52. Inert gas welding non-ferrous pipe stock to produce butt joints while fixed.

Sheet Metal

3. Cutting sheet metal with machinery to produce a straight cut within 1/32 of an inch.

5. Cutting sheet metal with machinery to produce a circular cut within 1/32 of an inch.

7. Cutting sheet metal with machinery to produce an irregular cut within 1/32 of an inch.

9. Cutting sheet metal with machinery to produce a notched cut within 1/32 of an inch.

11. Forming sheet metal cylinderical shapes on slip roll forming machine.

14. Forming single hem on bar folder or brake for strength.

15. Forming double hem on bar folder or brake for strength.

16. Forming single seam on a brake and/or bar folder for joining sheet metal parts.

17. Forming double seam on a brake and/or bar folder for joining sheet metal parts.

18. Forming Pittsburgh lock seam with machinery for joining sheet metal parts.

19. Forming cap strip seam on a drive cap machine for joining sheet metal parts.

21. Adhering sheet metal parts with adhesives to produce an assembly.

22. Welding (spot) sheet metal parts to produce an assembly.

23. Soldering sheet metal parts to produce an assembly.

26. Riveting sheet metal parts to produce an assembly.

Assembly

2. Adhering parts with adhesives using spray equipment to a specified thickness to produce a metal bonded assembly.

7. Mating parts together to produce sub-assemblies.

8. Mating parts and sub-assemblies together to produce major assemblies.

10. Cutting materials with hand tools to fit in an assembly.

11. Cutting materials with power tools to fit in an assembly to 1/32 of an inch.

15. Reaming stock with hand wrench to produce a finished hole to .001 of an inch.

16. Reaming stock with power drill to produce a finished hole to .001 of an inch.

19. Tapping holes with taps to produce a threaded hole.

20. Cutting threads with dies to produce a threaded member.

21. Punching materials with hand punches to produce a hole.

22. Punching materials with power tools to produce an assembly.

25. Measuring stock with precision instruments for assembly.

28. Flaring metal tubing with a flaring tool to produce a flare.

29. Aligning parts in sub-assemblies and assemblies with hand tools.

TASK ANALYSIS

METAL FORMING AND FABRICATION

This section of the report identifies the results of an analysis of the job entry tasks with respect to the areas of human requirement (communication, measurement, mathematics, science, skills, and information) needed for the performance of the tasks. The task statements and the areas of human requirement are written in behavioral terms which provide the instructor with a description of what the student should be able to do after he has had the learning experience. The areas of human requirement that are common to the occupations in the cluster have been determined and are identified in the following manner:

Δ Common to all occupations.

* Common to more than one occupation.

ø Common within the occupation.

MACHINING

TASK 1: TURNING STOCK ON LATHE TO PRODUCE A FACED SURFACE

COMMUNICATIONS

1. Reading blueprint to determine:
   - Δ a. Size and characteristics of the workpiece
   - Δ b. Type of operation
   - Δ c. Finish and accuracy required
   - * d. Number of parts to be machined
   - Δ e. Kind of material

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

MATHEMATICS

ø 1. Computing fractional equivalents of decimals.

ø 2. Computing automatic feed for various metals.

ø 3. Computing cutting speeds for various metals.

Δ 4. Applying knowledge of fractional parts of an inch:
   - a. Multiplying fractions to determine exact dimensions
   - b. Adding fractions to determine exact dimensions
   - c. Subtracting fractions to determine exact dimensions
   - d. Dividing fractions to determine exact dimensions

SCIENCE

ø 1. Explaining the physical properties of the machinability of various metals.

ø 2. Explaining gear and pulley drive ratios.

ø 3. Explaining heat transfer as it relates to coolants.

SKILLS

1. Laying out stock with a:
   - Δ a. Rule or scale
   - Δ b. Scriber

* 2. Cutting stock to length with:

a. Hand saw
b. Power hack saw
c. Power band saw

ø 3. Mounting:

a. Chuck
b. Collet
c. Face plate, in-on lathe

ø 4. Cleaning machine with rag and brush to obtain accurate set up.

ø 5. Mounting stock on the lathe with:

a. Chuck 3 jaw, 4 jaw
b. Collet
c. Face plate

ø 6. Mounting facing tool in holder in tool post and adjust point.

ø 7. Adjusting controls to obtain proper spindle speed.

ø 8. Adjusting controls to obtain proper feed.

ø 9. Setting depth of cut for roughing cut.

ø 10. Applying cutting fluids to lubricate cutting action and reduce cutting temperature.

11. Operating lathe to produce a faced surface.

ø 12. Setting depth of cut for finished cut.

Δ 13. Removing work from holding devices.

Δ 14. Removing burrs from finished work with:

a. File
b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tools for the task.

* 2. Selecting appropriate hacksaw blades for the task.

ø 3. Selecting method of holding stock to be machined.

a. Chuck 3 jaw, 4 jaw
b. Collet
c. Face plate

ø 4. Protecting V-Ways with wood when mounting chucks.

ø 5. Selecting proper facing tool for the job.

ø 6. Selecting methods of holding cutting tools.

ø 7. Selecting (from chart) correct cutting speeds for various metals.

ø 8. Selecting direction of cut.

ø 9. Removing and disposing of chips to keep work area clear and free from danger.

10. Practicing proper safety precautions when operating a lathe:

   * a. Wearing goggles or face shield
   * b. Wearing appropriate apparel
   ø c. Removing all tools before starting machine
   ø d. Making adjustments after machine has stopped
   * e. Using only cutting tools which have been adequately sharpened
   ø f. Maintaining all safety guards in place

ø 11. Selecting proper cutting fluids for various metals.

Δ 12. Selecting proper type of file.

Δ 13. Selecting abrasive cloth for removing burrs.

TASK 2: COUNTERSINKING (COUNTERSINK AND CENTER DRILL) STOCK TO PRODUCE A TAPERED HOLE FOR MOUNTING STOCK BETWEEN CENTERS

COMMUNICATIONS

1. Reading blueprint to determine:

   Δ a. Size and characteristics of the workpiece
   Δ b. Type of operation
   Δ c. Finish and accuracy required
   * d. Number of parts to be machined
   Δ e. Kind of material

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

MATHEMATICS

Ø 1. Computing fractional equivalents of decimals.

Δ 2. Applying knowledge of fractional parts of an inch:

  a. Multiplying fractions to determine exact dimensions
  b. Adding fractions to determine exact dimensions
  c. Subtracting fractions to determine exact dimensions
  d. Dividing fractions to determine exact dimensions

* 3. Applying knowledge of decimals:

  a. Adding decimals to determine exact dimensions
  b. Subtracting decimals to determine exact dimensions
  c. Multiplying decimals to determine exact dimensions
  d. Dividing decimals to determine exact dimensions

SCIENCE

Ø 1. Explaining the physical properties of the machinability of various metals.

Ø 2. Explaining gear and pulley drive ratios.

Ø 3. Explaining heat transfer as it relates to coolants.

SKILLS

1. Laying out stock with a:

  Δ a. Rule or scale
  * b. Center head
  * c. Hemaphrodite calipers
  * d. Surface gauge
  Δ e. Dividers
  Δ f. Scriber
  Δ g. Center punch

2. Cutting stock to length with:

  * a. Hand saw
  * b. Power hack saw
  * c. Power band saw

Ø 3. Mounting:

  a. Chuck
  b. Collet
  c. Face plate, in-on lathe

ø 4. Cleaning machine with cloth and brush to obtain accurate set up.

ø 5. Mounting stock on the lathe with:

   a. Chuck 3 jaw, 4 jaw
   b. Collet
   c. Face plate

ø 6. Mounting countersink and center drill in drill chuck in tail stock.

ø 7. Adjusting controls to obtain proper spindle speed.

ø 8. Applying cutting fluids to lubricate cutting action and reduce cutting temperature.

9. Operating lathe to produce a tapered hole.

Δ 10. Removing work from holding devices.

INFORMATION

Δ 1. Selecting appropriate layout tool for the task.

* 2. Selecting method of holding stock to be machined:

   a. Chuck 3 jaw, 4 jaw
   b. Collet
   c. Face plate

ø 3. Protecting V-Ways with wood when mounting chucks.

ø 4. Selecting proper countersink and center drill for the job.

5. Practicing proper safety precautions when operating a lathe:

   * a. Wearing goggles or face shield
   * b. Wearing appropriate apparel
   ø c. Removing all tools before starting machine
   ø d. Making adjustments after machine has stopped
   * e. Using only cutting tools which have been adequately sharpened
   ø f. Maintaining all safety guards in place

ø 6. Selecting proper cutting fluids for various metals.

TASK 3: TURNING STOCK ON LATHE TO PRODUCE A CYLINDERICAL SHAPE TO .001 OF AN INCH

COMMUNICATIONS

1. Reading blueprint to determine:
    - Δ a. Size and characteristics of the workpiece
    - Δ b. Type of operation
    - Δ c. Finish and accuracy required
    - * d. Number of parts to be machined
    - Δ e. Kind of material

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

* 2. Measuring stock with an outside caliper to determine size.

* 3. Measuring stock with a micrometer to determine size.

* 4. Measuring stock with a vernier caliper to determine size.

MATHEMATICS

ø 1. Determining fractional and decimal equivalents from chart.

ø 2. Computing fractional equivalents of decimals.

ø 3. Computing decimal equivalents of fractions.

ø 4. Computing automatic feed for various metals.

ø 5. Computing cutting speeds for various metals.

Δ 6. Applying knowledge of fractional parts of an inch:
    a. Multiplying fractions to determine exact dimensions
    b. Adding fractions to determine exact dimensions
    c. Subtracting fractions to determine exact dimensions
    d. Dividing fractions to determine exact dimensions

* 7. Applying knowledge of decimals:

    a. Adding decimals to determine exact dimensions
    b. Subtracting decimals to determine exact dimensions
    c. Multiplying decimals to determine exact dimensions
    d. Dividing decimals to determine exact dimensions

SCIENCE

ø 1. Explaining the physical properties of the machinability of various metals.

ø 2. Explaining gear and pulley drive ratios.

ø 3. Explaining heat transfer as it relates to coolants.

ø 4. Explaining the heat generated on the dead center of the lathe.

SKILLS

1. Laying out stock with a:

   Δ a. Square
   Δ b. Rule or scale
   * c. Center head
   * d. Hemaphrodite calipers
   * e. Surface gauge
   Δ f. Dividers
   Δ g. Scriber
   Δ h. Center punch

* 2. Cutting stock to length with:

   a. Hand saw
   b. Power hack saw
   c. Power band saw

ø 3. Mounting:

   a. Chuck
   b. Collet
   c. Face plate, in-on lathe
   d. Between centers

ø 4. Cleaning machine with cloth and brush to obtain accurate set up.

ø 5. Aligning lathe centers to produce an accurate cut.

ø 6. Applying lubricant to the dead center on the lathe.

ø 7. Mounting stock on the lathe with:

   a. Chuck 3 jaw, 4 jaw
   b. Collet
   c. Face plate
   d. Between centers

ø 8. Mounting turning tool in holder in tool post and adjust point.

ø 9. Adjusting controls to obtain proper spindle speed.

ø 10. Adjusting controls to obtain proper feed.

ø 11. Setting depth of cut for roughing out.

ø 12. Applying cutting fluids to lubricate cutting action and reduce cutting temperature.

13. Operating lathe to produce a cylinderical shape to .001 of an inch.

ø 14. Setting depth of cut for finished cut.

Δ 15. Removing work from holding devices.

Δ 16. Removing burrs from finished work with:

    a. File
    b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tool for the task.

* 2. Selecting appropriate hacksaw blades for the task.

ø 3. Selecting method of holding stock to be machined:

    a. Chuck 3 jaw, 4 jaw
    b. Collet
    c. Face plate
    d. Between centers

ø 4. Protecting V-Ways with wood when mounting chucks.

ø 5. Selecting proper turning tool for the job.

ø 6. Selecting methods of holding cutting tools.

ø 7. Selecting (from chart) correct cutting speeds for various metals.

ø 8. Selecting direction of cut.

ø 9. Removing and disposing of chips to keep work area clear and free from danger.

10. Practicing proper safety precautions when operating a lathe:

    * a. Wearing goggles or face shield
    * b. Wearing appropriate apparel
    ø c. Removing all tools before starting machine
    ø d. Making adjustments after machine has stopped

* e. Using only cutting tools which have been adequately sharpened
ø f. Maintaining all safety guards in place

ø 11. Selecting proper cutting fluids for various metals.

ø 12. Selecting proper lubricant for the dead center on the lathe.

Δ 13. Selecting proper type of file.

Δ 14. Selecting abrasive cloth for removing burrs.

TASK 4: TURNING STOCK ON LATHE TO PRODUCE A SHOULDER TO .001 OF AN INCH

COMMUNICATIONS

1. Reading blueprint to determine:

Δ a. Size and characteristics of the workpiece
Δ b. Type of operation
Δ c. Finish and accuracy required
* d. Number of parts to be machined
Δ e. Kind of material

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

* 2. Measuring stock with an outside caliper to determing size.

* 3. Measuring stock with a micrometer to determine size.

* 4. Measuring stock with a vernier caliper to determine size.

MATHEMATICS

ø 1. Determining fractional and decimal equivalents from chart.

ø 2. Computing fractional equivalents of decimals.

ø 3. Computing decimal equivalents of fractions.

ø 4. Computing automatic feed for various metals.

ø 5. Computing cutting speeds for various metals.

Δ 6. Applying knowledge of fractional parts of an inch:

  a. Multiplying fractions to determine exact dimensions
  b. Adding fractions to determine exact dimensions
  c. Subtracting fractions to determine exact dimensions
  d. Dividing fractions to determine exact dimensions

* 7. Applying knowledge of decimals:

  a. Adding decimals to determine exact dimensions
  b. Subtracting decimals to determine exact dimensions
  c. Multiplying decimals to determine exact dimensions
  d. Dividing decimals to determine exact dimensions

SCIENCE

ϕ 1. Explaining the physical properties of the machinability of various metals.

ϕ 2. Explaining gear and pulley drive ratios.

ϕ 3. Explaining heat transfer as it relates to coolants.

SKILLS

1. Laying out stock with a :

  Δ a. Square
  Δ b. Rule or scale
  * c. Center head
  * d. Hemaphrodite calipers
  * e. Surface gauge
  Δ f. Dividers
  Δ g. Scriber
  Δ h. Center punch

* 2. Cutting stock to length with:

  a. Hand saw
  b. Power hack saw
  c. Power band saw

ϕ 3. Mounting:

  a. Chuck
  b. Collet
  c. Face plate, in-on lathe
  d. Between centers

ϕ 4. Cleaning machine with cloth and brush to obtain accurate set up.

ø 5. Aligning lathe centers to produce an accurate cut.

ø 6. Applying lubricant to the dead center on the lathe.

ø 7. Mounting stock on the lathe with:

    a. Chuck 3 jaw, 4 jaw
    b. Collet
    c. Face plate
    d. Between centers

ø 8. Mounting turning tool in holder in tool post and adjust point.

ø 9. Adjusting controls to obtain proper spindle speed.

ø 10. Adjusting controls to obtain proper feed.

ø 11. Setting depth of cut for roughing cut.

ø 12. Applying cutting fluids to lubricate cutting action and reduce cutting temperature.

13. Operating lathe to produce a shoulder to .001 of an inch.

ø 14. Setting depth of cut for finished cut.

Δ 15. Removing work from holding devices.

Δ 16. Removing burrs from finished work with:

    a. File
    b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tool for the task.

* 2. Selecting appropriate hacksaw blades for the task.

ø 3. Selecting method of holding stock to be machined:

    a. Chuck 3 jaw, 4 jaw
    b. Collet
    c. Face plate
    d. Between centers

ø 4. Protecting V-Ways with wood when mounting chucks.

ø 5. Selecting proper turning tool for the job.

ø 6. Selecting methods of holding cutting tool.

ø 7. Selecting (from chart) correct cutting speeds for various metals.

ϕ 8. Selecting direction of cut.

ϕ 9. Removing and disposing of chips to keep work area clear and free from danger.

10. Practicing proper safety precautions when operating a lathe:

    * a. Wearing goggles or face shield
    * b. Wearing appropriate apparel
    ϕ c. Removing all tools before starting machine
    ϕ d. Making adjustments after machine has stopped
    * e. Using only cutting tools which have been adequately sharpened
    ϕ f. Maintaining all safety guards in place

ϕ 11. Selecting proper cutting fluids for various metals.

ϕ 12. Selecting proper lubricant for the dead center on the lathe.

Δ 13. Selecting proper type of file.

Δ 14. Selecting abrasive cloth for removing burrs.

TASK 5: DRILLING STOCK ON LATHE TO PRODUCE A HOLE TO .005 OF AN INCH

COMMUNICATIONS

1. Reading blueprint to determine:

    Δ a. Size and characteristics of the workpiece
    Δ b. Type of operation
    Δ c. Finish and accuracy required
    * d. Number of parts to be machined
    Δ e. Kind of material

MEASUREMENT

1. Reading graduations on tail stock to determine depth of hole.

MATHEMATICS

ϕ 1. Determining fractional and decimal equivalents from chart.

ϕ 2. Computing fractional equivalents of decimals.

ϕ 3. Computing decimal equivalents of fractions.

ϕ 4. Computing cutting speeds for various metals.

Δ 5. Applying knowledge of fractional parts of an inch:

  a. Multiplying fractions to determine exact dimensions
  b. Adding fractions to determine exact dimensions
  c. Subtracting fractions to determine exact dimensions
  d. Dividing fractions to determine exact dimensions

* 6. Applying knowledge of decimals:

  a. Adding decimals to determine exact dimensions
  b. Subtracting decimals to determine exact dimensions
  c. Multiplying decimals to determine exact dimensions
  d. Dividing decimals to determine exact dimensions

SCIENCE

ϕ 1. Explaining the physical properties of the machinability of various metals.

ϕ 2. Explaining gear and pulley drive ratios.

ϕ 3. Explaining heat transfer as it relates to coolants.

SKILLS

1. Laying out stock with a:

  Δ a. Square
  Δ b. Rule or scale
  * c. Center head
  * d. Hemaphrodite calipers
  * e. Surface gauge
  Δ f. Dividers
  Δ g. Scriber
  Δ h. Center punch

* 2. Cutting stock to length with:

  a. Hand saw
  b. Power hack saw
  c. Power band saw

ϕ 3. Mounting:

  a. Chuck
  b. Collet
  c. Face plate, in-on lathe

ϕ 4. Cleaning machine with cloth and brush to obtain accurate set up.

ø 5. Mounting stock on the lathe with:

    a. Chuck 3 jaw, 4 jaw
    b. Collet
    c. Face plate

6. Mounting drill in:

    a. Tail stock-tapered shank
    * b. Drill chuck-straight shank

ø 7. Adjusting controls to obtain proper spindle speed.

ø 8. Applying cutting fluids to lubricate cutting action and reduce cutting temperature.

9. Operating lathe to produce a hole to .005 of an inch.

Δ 10. Removing work from holding devices.

* 11. Removing burrs from work with an old drill.

INFORMATION

Δ 1. Selecting appropriate layout tool for the task.

* 2. Selecting appropriate hacksaw blades for the task.

ø 3. Selecting method of holding stock to be machined:

    a. Chuck 3 jaw, 4 jaw
    b. Collet
    c. Face plate

ø 4. Protecting V-Ways with wood when mounting chucks.

* 5. Selecting proper drill for the job.

* 6. Selecting methods of holding drill.

ø 7. Selecting (from chart) correct cutting speeds for various metals.

ø 8. Removing and disposing of chips to keep work area clear and free from danger.

9. Practicing proper safety precautions when operating a lathe:

    * a. Wearing goggles or face shield
    * b. Wearing appropriate apparel
    ø c. Removing all tools before starting machine
    ø d. Making adjustments after machine has stopped
    * e. Using only cutting tools which have been adequately sharpened
    ø f. Maintaining all safety guards in place

ø 10. Selecting proper cutting fluids for various metals.

TASK 6: REAMING STOCK ON LATHE TO PRODUCE A FINISHED HOLE TO .001 OF AN INCH

COMMUNICATIONS

1. Reading blueprint to determine:
    - Δ a. Size and characteristics of the workpiece
    - Δ b. Type of operation
    - Δ c. Finish and accuracy required
    - * d. Number of parts to be machined
    - Δ e. Kind of material

MEASUREMENT

* 1. Measuring stock with an inside micrometer to determine size.

ø 2. Measuring stock with a plug gauge to determine size.

ø 3. Reading graduations on tail stock to determine depth of hole.

MATHEMATICS

ø 1. Determining fractional and decimal equivalents from charts.

ø 2. Computing fractional equivalents of decimals.

ø 3. Computing decimal equivalents of fractions.

Δ 4. Applying knowledge of fractional parts of an inch:
- a. Multiplying fractions to determine exact dimensions
- b. Adding fractions to determine exact dimensions
- c. Subtracting fractions to determine exact dimensions
- d. Dividing fractions to determine exact dimenions

* 5. Applying knowledge of decimals:
- a. Adding decimals to determine exact dimensions
- b. Subtracting decimals to determine exact dimensions
- c. Multiplying decimals to determine exact dimensions
- d. Dividing decimals to determine exact dimensions

SCIENCE

ø 1. Explaining the physical properties of the machinability of various metals.

ø 2. Explaining gear and pulley drive ratios.

ø 3. Explaining heat transfer as it relates to coolants.

SKILLS

ø 1. Mounting:

   a. Chuck
   b. Collet
   c. Face plate, in-on lathe

ø 2. Cleaning machine with cloth and brush to obtain accurate set up.

ø 3. Mounting stock on the lathe with:

   a. Chuck, 3 jaw, 4 jaw
   b. Collet
   c. Face plate

4. Mounting reamer in:

   a. Tail stock-tapered shank
   * b. Drill chuck-straight shank

ø 5. Adjusting controls to obtain proper spindle speed.

6. Operating lathe to produce a finished hole.

Δ 7. Removing work from holding devices.

* 8. Removing burrs from work with old drill.

INFORMATION

ø 1. Selecting method of holding stock to be machined:

   a. Chuck 3 jaw, 4 jaw
   b. Collet
   c. Face plate

ø 2. Protecting V-Ways with wood when mounting chucks.

* 3. Selecting proper reamer for the job.

* 4. Selecting methods of holding reamer.

5. Practicing proper safety precautions when operating a lathe:

   * a. Wearing goggles or face shield
   * b. Wearing appropriate apparel
   ø c. Removing all tools before starting machine

- ø d. Making adjustments after machine has stopped
- * e. Using only cutting tools which have been adequately sharpened
- ø f. Maintaining all safety guards in place

ø 6. Selecting proper cutting fluids for various metals.

TASK 7: BORING STOCK ON LATHE TO PRODUCE AN ENLARGED HOLE TO .001 OF AN INCH

COMMUNICATIONS

1. Reading blueprint to determine:
    - Δ a. Size and characteristics of the workpiece
    - Δ b. Type of operation
    - Δ c. Finish and accuracy required
    - * d. Number of parts to be machined
    - Δ e. Kind of material

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

* 2. Measuring stock with an inside caliper to determine size.

* 3. Measuring stock with an inside micrometer to determine size.

* 4. Measuring stock with a vernier caliper to determine size.

MATHEMATICS

ø 1. Determining fractional and decimal equivalents from charts.

ø 2. Computing fractional equivalents of decimals.

ø 3. Computing decimal equivalents of fractions.

ø 4. Computing automatic feed for various metals.

ø 5. Computing cutting speeds for various metals.

Δ 6. Applying knowledge of fractional parts of an inch:

- a. Multiplying fractions to determine exact dimensions
- b. Adding fractions to determine exact dimentions
- c. Subtracting fractions to determine exact dimensions
- d. Dividing fractions to determine exact dimensions

* 7. Applying knowledge of decimals:

   a. Adding decimals to determine exact dimensions
   b. Subtracting decimals to determine exact dimensions
   c. Multiplying decimals to determine exact dimensions
   d. Dividing decimals to determine exact dimensions

SCIENCE

ϕ 1. Explaining the physical properties of the machinability of various metals.

ϕ 2. Explaining gear and pulley drive ratios.

ϕ 3. Explaining heat transfer as it relates to coolants.

SKILLS

ϕ 1. Mounting:

   a. Chuck
   b. Face Plate
      (in-on lathe)

ϕ 2. Cleaning machine with cloth and brush to obtain accurate set up.

ϕ 3. Mounting stock on the lathe with:

   a. Chuck 3 jaw, 4 jaw
   b. Face plate

ϕ 4. Mounting boring tool in holder in tool post and adjust point.

ϕ 5. Adjusting controls to obtain proper spindle speed.

ϕ 6. Adjusting controls to obtain proper feed.

ϕ 7. Setting depth of cut for roughing out.

ϕ 8. Applying cutting fluids to lubricate cutting action and reduce cutting temperature.

9. Operating lathe to produce an enlarged hole.

ϕ 10. Setting depth of cut for finished cut.

Δ 11. Removing burrs from finished work with an abrasive cloth.

INFORMATION

ϕ 1. Selecting method of holding stock to be machined:

    a. Chuck 3 jaw, 4 jaw
    b. Face plate

ϕ 2. Protecting V-Ways with wood when mounting chucks.

ϕ 3. Selecting proper boring tool for the job.

ϕ 4. Selecting methods of holding boring tool.

ϕ 5. Selecting (from chart) correct cutting speeds for various metals.

ϕ 6. Selecting direction of cut.

ϕ 7. Removing and disposing of chips to keep work area clear and free from danger.

8. Practicing proper safety precautions when operating a lathe:

    * a. Wearing goggles or face shield
    * b. Wearing appropriate apparel
    ϕ c. Removing all tools before starting machine
    ϕ d. Making adjustments after machine has stopped
    * e. Using only cutting tools which have been adequately sharpened
    ϕ f. Maintaining all safety guards in place

ϕ 9. Selecting proper cutting fluids for various metals.

Δ 10. Selecting abrasive cloth for removing burrs.

TASK 8: COUNTERBORING STOCK ON LATHE TO PRODUCE A RECESSED HOLE TO .005 OF AN INCH

COMMUNICATIONS

1. Reading blueprint to determine:

    Δ a. Size and characteristics of the workpiece
    Δ b. Type of operation
    Δ c. Finish and accuracy required
    * d. Number of parts to be machined
    Δ e. Kind of material

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

MATHEMATICS

∅ 1. Determining fractional and decimal equivalents from charts.

∅ 2. Computing fractional equivalents of decimals.

∅ 3. Computing decimal equivalents of fractions.

∅ 4. Computing automatic feed for various metals.

∅ 5. Computing cutting speeds for various metals.

Δ 6. Applying knowledge of fractional parts of an inch:

  a. Multiplying fractions to determine exact dimensions
  b. Adding fractions to determine exact dimensions
  c. Subtracting fractions to determine exact dimensions
  d. Dividing fractions to determine exact dimensions

* 7. Applying knowledge of decimals:

  a. Adding decimals to determine exact dimensions
  b. Subtracting decimals to determine exact dimensions
  c. Multiplying decimals to determine exact dimensions
  d. Dividing decimals to determine exact dimensions

SCIENCE

∅ 1. Explaining the physical properties of the machinability of various metals.

∅ 2. Explaining gear and pulley drive ratios.

∅ 3. Explaining heat transfer as it relates to coolants.

SKILLS

∅ 1. Mounting:

  a. Chuck
  b. Face plate, in-on lathe

∅ 2. Cleaning machine with cloth and brush to obtain accurate set up.

ϕ 3. Mounting stock on the lathe with:

   a. Chuck 3 jaw, 4 jaw
   b. Face plate

4. Mounting:

   a. Counterboring tool in tail stock
   b. Boring bar in tool holder

ϕ 5. Adjusting controls to obtain proper spindle speed.

ϕ 6. Applying cutting fluids to lubricate cutting action and reduce cutting temperature.

7. Operating lathe to produce a recessed hole.

Δ 8. Removing work from holding devices.

Δ 9. Removing burrs from finished work with an abrasive cloth.

INFORMATION

Δ 1. Selecting appropriate layout tool for the task.

* 2. Selecting appropriate hacksaw blades for the task.

ϕ 3. Selecting method of holding stock to be machined:

   a. Chuck 3 jaw, 4 jaw
   b. Face plate

ϕ 4. Protecting V-Ways with wood when mounting chucks.

ϕ 5. Selecting proper counterboring tool for the job.

ϕ 6. Selecting methods of holding cutting tool.

ϕ 7. Removing and disposing of chips to keep work area clear and free from danger.

8. Practicing proper safety precautions when operating a lathe:

   * a. Wearing goggles or face shield
   * b. Wearing appropriate apparel
   ϕ c. Removing all tools before starting machine
   ϕ d. Making adjustments after machine has stopped
   * e. Using only cutting tools which have been adequately sharpened
   ϕ f. Maintaining all safety guards in place

ϕ 9. Selecting proper cutting fluids for various metals.

Δ 10. Selecting abrasive cloth for removing burrs.

TASK 9: PARTING STOCK ON LATHE TO PRODUCE A PIECE WITHIN 1/32 OF AN INCH IN LENGTH

COMMUNICATIONS

1. Reading blueprint to determine:

    Δ a. Size and characteristics of the workpiece
    Δ b. Type of operation
    Δ c. Finish and accuracy required
    * d. Number of parts to be machined
    Δ e. Kind of material

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

* 2. Measuring stock with outside caliper to determine size.

MATHEMATICS

ϕ 1. Determining fractional and decimal equivalents from charts.

ϕ 2. Computing fractional equivalents of decimals.

ϕ 3. Computing decimal equivalents of fractions.

ϕ 4. Computing automatic feed for various metals.

ϕ 5. Computing cutting speeds for various metals.

Δ 6. Applying knowledge of fractional parts of an inch:

    a. Multiplying fractions to determine exact dimensions
    b. Adding fractions to determine exact dimensions
    c. Subtracting fractions to determine exact dimensions
    d. Dividing fractions to determine exact dimensions

* 7. Applying knowledge of decimals:

    a. Adding decimals to determine exact dimensions
    b. Subtracting decimals to determine exact dimensions
    c. Multiplying decimals to determine exact dimensions
    d. Dividing decimals to determine exact dimensions

SCIENCE

ø 1. Explaining the physical properties of the machinability of various metals.

ø 2. Explaining gear and pulley drive ratios.

ø 3. Explaining heat transfer as it relates to coolants.

SKILLS

1. Laying out stock with a:

   Δ a. Square
   Δ b. Rule or scale
   * c. Center head
   * d. Hemaphrodite calipers
   * e. Surface gauge
   Δ f. Dividers
   Δ g. Scriber
   Δ h. Center punch

* 2. Cutting stock to length with:

   a. Hand saw
   b. Power hack saw
   c. Power band saw

ø 3. Mounting:

   a. Chuck
   b. Collet, in-on lathe

ø 4. Cleaning machine with cloth and brush to obtain accurate set up.

ø 5. Mounting stock on the lathe with:

   a. Chuck 3 jaw, 4 jaw
   b. Collet

ø 6. Mounting parting tool in holder in tool post and adjust point.

ø 7. Adjusting controls to obtain proper spindle speed.

ø 8. Adjusting control to obtain proper feed.

ø 9. Applying cutting fluids to lubricate cutting action and reduce cutting temperature.

10. Operating lathe to produce a piece within 1/32 of an inch in length.

Δ 11. Removing work from holding devices.

Δ 12. Removing burrs from finished work with:

    a. File
    b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tool for the task.

* 2. Selecting appropriate hacksaw blades for the task.

ø 3. Selecting method of holding stock to be machined:

    a. Chuck 3 jaw, 4 jaw
    b. Collet

ø 4. Protecting V-Ways with wood when mounting chucks.

ø 5. Selecting proper parting tool for the job.

ø 6. Selecting methods of holding cutting tool.

ø 7. Selecting (from chart) correct cutting speeds for various metals.

ø 8. Removing and disposing of chips to keep work area clear and free from danger.

9. Practicing proper safety precautions when operating a lathe:

    * a. Wearing goggles or face shield
    * b. Wearing appropriate apparel
    ø c. Removing all tools before starting machine
    ø d. Making adjustments after machine has stopped
    * e. Using only cutting tools which have been adequately sharpened
    ø f. Maintaining all safety guards in place

ø 10. Selecting proper cutting fluids for various metals.

Δ 11. Selecting proper type of file.

Δ 12. Selecting abrasive cloth for removing burrs.

TASK 10: NECKING STOCK ON LATHE TO PRODUCE A NECKED SHAPE TO 1/32 OF AN INCH

COMMUNICATIONS

1. Reading blueprint to determine:

   Δ a. Size and characteristics of the workpiece
   Δ b. Type of operation
   Δ c. Finish and accuracy required
   * d. Number of parts to be machined
   Δ e. Kind of material

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

* 2. Measuring stock with an outside caliper to determine size.

MATHEMATICS

Ø 1. Determining fractional and decimal equivalents from charts.

Ø 2. Computing fractional equivalents of decimals.

Ø 3. Computing decimal equivalents of fractions.

Ø 4. Computing automatic feed for various metals.

Ø 5. Computing cutting speeds for various metals.

Δ 6. Applying knowledge of fractional parts of an inch:

   a. Multiplying fractions to determine exact dimensions
   b. Adding fractions to determine exact dimensions
   c. Subtracting fractions to determine exact dimensions
   d. Dividing fractions to determine exact dimensions

* 7. Applying knowledge of decimals:

   a. Adding decimals to determine exact dimensions
   b. Subtracting decimals to determine exact dimensions
   c. Multiplying decimals to determine exact dimensions
   d. Dividing decimals to determine exact dimensions

SCIENCE

Ø 1. Explaining the physical properties of the machinability of various metals.

Ø 2. Explaining gear and pulley drive ratios.

Ø 3. Explaining heat transfer as it relates to coolants.

ϕ 4. Explaining the heat generated on the dead center on the lathe.

SKILLS

1. Laying out stock with a:

   Δ a. Square
   Δ b. Rule or scale
   * c. Center head
   * d. Hemaphrodite calipers
   * e. Surface gauge
   Δ f. Dividers
   Δ g. Scriber
   Δ h. Center punch

* 2. Cutting stock to length with:

   a. Hand saw
   b. Power hack saw
   c. Power band saw

ϕ 3. Mounting:

   a. Chuck
   b. Collet
   c. Face plate
   d. Between centers, in-on lathe

ϕ 4. Cleaning machine with cloth and brush to obtain accurate set up.

ϕ 5. Applying lubricant to the dead center on the lathe.

ϕ 6. Mounting stock on the lathe with:

   a. Chuck 3 jaw, 4 jaw
   b. Collet
   c. Face plate
   d. Between centers

ϕ 7. Mounting facing tool in holder in tool post and adjust point.

ϕ 8. Adjusting controls to obtain proper spindle speed.

ϕ 9. Setting depth of cut for roughing cut.

ϕ 10. Applying cutting fluids to lubricate cutting action and reduce cutting temperature.

11. Operating lathe to produce a faced surface.

ϕ 12. Setting depth of cut for finished cut.

Δ 13. Removing work from holding devices.

Δ 14. Removing burrs from finished work with:

    a. File
    b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tool for the task.

* 2. Selecting appropriate hacksaw blades for the task.

ø 3. Selecting method of holding stock to be machined:

    a. Chuck 3 jaw, 4 jaw
    b. Collet
    c. Face plate
    d. Between centers

ø 4. Protecting V-Ways with wood when mounting chucks.

ø 5. Selecting proper necking tool for the job.

ø 6. Selecting methods of holding cutting tools.

ø 7. Selecting (from charts) correct cutting speeds for various metals.

ø 8. Removing and disposing of chips to keep work area clear and free from danger.

9. Practicing proper safety precautions when operating a lathe:

    * a. Wearing goggles or face shield
    * b. Wearing appropriate apparel
    ø c. Removing all tools before starting machine
    ø d. Making adjustments after machine has stopped
    * e. Using only cutting tools which have been adequately sharpened
    ø f. Maintaining all safety guards in place

ø 10. Selecting proper cutting fluids for various metals.

ø 11. Selecting proper lubricant for dead center on the lathe.

Δ 12. Selecting proper type of file.

Δ 13. Selecting abrasive cloth for removing burrs.

TASK 11: FILING STOCK ON LATHE TO PRODUCE A FINISHED SURFACE

COMMUNICATIONS

1. Reading blueprint to determine:
   - Δ a. Size and characteristics of the workpiece
   - Δ b. Type of operation
   - Δ c. Finish and accuracy required
   - * d. Number of parts to be machined
   - Δ e. Kind of material

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

* 2. Measuring stock with a micrometer to determine size.

* 3. Measuring stock with a vernier caliper to determine size.

MATHEMATICS

ø 1. Determining fractional and decimal equivalents from chart.

ø 2. Computing fractional equivalents of decimals.

ø 3. Computing decimal equivalents of fractions.

ø 4. Computing automatic feed for various metals.

ø 5. Computing cutting speeds for various metals.

Δ 6. Applying knowledge of fractional parts of an inch:

   a. Multiplying fractions to determine exact dimensions
   b. Adding fractions to determine exact dimensions
   c. Subtracting fractions to determine exact dimensions
   d. Dividing fractions to determine exact dimensions

* 7. Applying knowledge of decimals:

   a. Adding decimals to determine exact dimensions
   b. Subtracting decimals to determine exact dimensions
   c. Multiplying decimals to determine exact dimensions
   d. Dividing decimals to determine exact dimensions

SCIENCE

ø 1. Explaining the physical properties of the machinability of various metals.

ø 2. Explaining gear and pulley drive ratios.

ø 3. Explaining heat transfer as it relates to coolants.

ø 4. Explaining the heat generated on the dead center on the lathe.

SKILLS

ø 1. Mounting:

  - a. Chuck
  - b. Collet
  - c. Face plate
  - d. Between centers, in-on lathe

ø 2. Cleaning machine with cloth and brush to obtain accurate set up.

ø 3. Mounting stock on the lathe with:

  - a. Chuck 3 jaw, 4 jaw
  - b. Collet
  - c. Face plate
  - d. Between centers

ø 4. Adjusting controls to obtain proper spindle speed.

5. Operating lathe to produce a finished surface.

Δ 6. Removing work from holding devices.

Δ 7. Removing burrs from finished work with:

  - a. File
  - b. Abrasive cloth

INFORMATION

ø 1. Selecting method of holding stock to be machined:

  - a. Chuck 3 jaw, 4 jaw
  - b. Collet
  - c. Face plate
  - d. Between centers

ø 2. Protecting V-Ways with wood when mounting chucks.

ø 3. Selecting direction of cut.

4. Practicing proper safety precautions when operating a lathe:

* a. Wearing goggles or face shield
* b. Wearing appropriate apparel
ø c. Removing all tools before starting machine
ø d. Making adjustments after machine has stopped
* e. Using only cutting tools which have been adequately sharpened
ø f. Maintaining all safety guards in place

Δ 5. Selecting proper type of file.

Δ 6. Selecting abrasive cloth for removing burrs.

TASK 12: MACHINING STOCK ON SHAPER TO PRODUCE A FLAT SURFACE

COMMUNICATIONS

1. Reading blueprint to determine:

Δ a. Size and characteristics of the workpiece
Δ b. Type of operation
Δ c. Finish and accuracy required
* d. Number of parts
Δ e. Kind of material

MEASUREMENT

* 1. Measuring stock with a rule or scale to determine length.

ø 2. Reading graduations on cross feed screw to determine depth of cut.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

a. Multiplying fractions to determine exact dimensions
b. Adding fractions to determine exact dimensions
c. Subtracting fractions to determine exact dimensions
d. Dividing fractions to determine exact dimensions

* 2. Applying knowledge of decimals:

a. Adding decimals to determine exact dimensions
b. Subtracting decimals to determine exact dimensions
c. Multiplying decimals to determine exact dimensions
d. Dividing decimals to determine exact dimensions

3. Computing ram speed and feed of shaper according to size and type of material being machined.

SCIENCE

ø 1. Explaining the physical properties of the machinability of various metals.

ø 2. Explaining heat transfer as it relates to coolants.

SKILLS

1. Laying out stock with a:
    - Δ a. Square
    - Δ b. Rule or scale
    - * c. Surface gauge
    - Δ d. Dividers
    - Δ e. Scriber

* 2. Cutting stock to length with:
    - a. Hand saw
    - b. Power hack saw
    - c. Power band saw

ø 3. Cleaning machine with cloth and brush to obtain accurate set up.

Δ 4. Mounting stock on shaper with:
    - a. Clamps
    - b. Vise

ø 5. Mounting cutting tool in tool holder.

6. Adjusting position of ram according to size of material being machined.

7. Adjusting length of the stroke of ram.

8. Adjusting controls to obtain proper ram speed and feed of shaper according to size and type of material being machined.

ø 9. Aligning cutting tool with stock to be machined.

ø 10. Setting depth of cut for roughing cut.

11. Operating shaper to produce a flat surface.

ø 12. Setting depth of cut for finished cut.

Δ 13. Removing work from holding devices.

Δ 14. Removing burrs from finished work with:

  a. File
  b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tools for the task.

* 2. Selecting appropriate hacksaw blades for the task.

Δ 3. Selecting proper method of mounting work:

  a. Vise
  b. Clamps

ø 4. Selecting proper cutting tool for the operation.

ø 5. Removing and disposing of chips to keep work area clear and free from danger.

6. Practicing proper safety precautions when operating a shaper:

  * a. Wearing goggles or face shield
  * b. Wearing appropriate apparel
  ø c. Removing all tools before starting machine
  ø d. Making adjustments after machine has stopped
  * e. Using only cutting tools which have been adequately sharpened
  ø f. Maintaining all safety guards in place

Δ 7. Selecting proper type of file.

Δ 8. Selecting abrasive cloth for removing burrs.

TASK 13: MACHINING STOCK ON SHAPER TO PRODUCE TWO PARALLEL SURFACES TO .005 OF AN INCH

COMMUNICATIONS

1. Reading blueprint to determine:

  Δ a. Size and characteristics of the workpiece

Δ b. Type of operation
Δ c. Finish and accuracy required
* d. Number of parts

MEASUREMENT

ø 1. Reading graduations on cross feed screw to determine depth of cut.

* 2. Measuring stock with a micrometer to determine size.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

  a. Multiplying fractions to determine exact dimensions
  b. Adding fractions to determine exact dimensions
  c. Subtracting fractions to determine exact dimensions
  d. Dividing fractions to determine exact dimensions

* 2. Applying knowledge of decimals:

  a. Adding decimals to determine exact dimensions
  b. Subtracting decimals to determine exact dimensions
  c. Multiplying decimals to determine exact dimensions
  d. Dividing decimals to determine exact dimensions

SCIENCE

ø 1. Explaining the physical properties of the machinability of various metals.

ø 2. Explaining heat transfer as it relates to coolants.

SKILLS

1. Laying out stock with a:

  Δ a. Square
  Δ b. Rule or scale
  * c. Surface gauge
  Δ d. Dividers
  Δ e. Scriber

ø 2. Cleaning machine with cloth and brush to obtain accurate set up.

Δ 3. Mounting stock on shaper with:

  a. Clamps
  b. Vise

ø 4. Mounting cutting tool in tool holder.

ø 5. Aligning cutting tool with stock to be machined.

ø 6. Setting depth of cut for roughing cut.

7. Operating shaper to produce two parallel surfaces to .001 of an inch.

ø 8. Setting depth of cut for finished cut.

Δ 9. Removing work from holding devices.

Δ 10. Removing burrs from finished work with:

    a. File
    b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tools for the task.

ø 2. Removing and disposing of chips to keep work area clear and dree from danger.

3. Practicing proper safety precautions when operating a shaper:

    * a. Wearing goggles or face shield
    * b. Wearing appropriate apparel
    ø c. Removing all tools before starting machine
    ø d. Making adjustments after machine has stopped
    * e. Using only cutting tools which have been adequately sharpened
    ø f. Maintaining all safety guards in place

Δ 4. Selecting proper type of file.

Δ 5. Selecting abrasive cloth for removing burrs.

TASK 14: DRILLING STOCK ON DRILL PRESS TO PRODUCE A HOLE TO .005 OF AN INCH

COMMUNICATIONS

1. Reading blueprints to determine:

    Δ a. Size and characteristics of part
    * b. Size and depth of hole

* c. Number of parts to be drilled
Δ d. Accuracy required

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

MATHEMATICS

ϕ 1. Determining decimal equivalent of fractions from charts.

ϕ 2. Computing decimal equivalents of fractions.

Δ 3. Applying knowledge of fractional parts of an inch:

a. Multiplying fractions to determine exact dimensions
b. Adding fractions to determine exact dimensions
c. Subtracting fractions to determine exact dimensions
d. Dividing fractions to determine exact dimensions

* 4. Applying knowledge of decimals:

a. Adding decimals to determine exact dimensions
b. Subtracting decimals to determine exact dimensions
c. Multiplying decimals to determine exact dimensions
d. Dividing decimals to determine exact dimensions

SCIENCE

ϕ 1. Explaining the physical properties of the machinability of various metals.

ϕ 2. Explaining pulley drive ratios.

ϕ 3. Explaining heat transfer as it relates to coolants.

SKILLS

* 1. Cutting stock to length with:

a. Hand saw
b. Power hack saw
c. Power hand saw

2. Laying out stock with a:

Δ a. Square
Δ b. Rule or scale
* c. Center head
* d. Hemaphrodite calipers

- * e. Surface gauge
- Δ f. Dividers
- Δ g. Scriber
- Δ h. Center punch

3. Mounting (driving) drill in spindle of drill press:
    - * a. Straight
    - b. Taper shank

ϕ 4. Adjusting controls to obtain proper spindle speed for machining.

5. Mounting holding device on drill press table:
    - Δ a. Vise
    - ϕ b. Vee block
    - Δ c. Clamps
    - ϕ d. Angle plate
    - ϕ e. Jigs & fixtures

ϕ 6. Cleaning machine with cloth and brush to obtain accurate set up.

7. Mounting work in holding devices:
    - Δ a. Vise
    - ϕ b. Vee block
    - Δ c. Clamps
    - ϕ d. Angle plate
    - ϕ e. Jigs & fixtures

ϕ 8. Adjusting depth stop for specific hole depth.

9. Positioning stop blocks for multiple drilling of parts.

ϕ 10. Centering work with respect to the spindle.

* 11. Aligning center punch mark with drill.

* 12. Operating drill press to produce hole.

ϕ 13. Applying cutting fluids to lubricate cutting action and reduce cutting temperature.

Δ 14. Removing work from holding devices.

Δ 15. Removing burrs from finished work with:
- * a. Old drill
- Δ b. Abrasive cloth

INFORMATION

1. Selecting appropriate hacksaw blades for the task.

2. Selecting appropriate layout tools for the task.

3. Selecting proper drill according to specifications:

    a. Material being machined
    b. Fractional
    c. Letter
    d. Number

4. Selecting (from charts) proper speeds for various materials.

5. Selecting method for holding stock to be machined:

    Δ a. Vises
    Ø b. Vee blocks
    Δ c. Clamps
    Ø d. Angle plates
    Ø e. Jigs & fixtures

Ø 6. Aligning work to prevent drilling into holding devices.

7. Practicing proper safety precautions when operating a a drill press:

    * a. Wearing goggles or face shield.
    * b. Wearing appropriate apparel.
    Ø c. Removing all tools before starting machine
    Ø d. Making adjustments after machine has stopped
    * e. Using only cutting tools which have been adequately sharpened.
    Ø f. Maintaining all safety guards in place.

Ø 8. Removing and disposing of chips to keep work area clear and free from danger.

Ø 9. Selecting proper cutting fluids for various metals.

10. Adjusting table for angular hole drilling.

Δ 11. Selecting abrasive cloth for removing burrs.

TASK 15: REAMING A HOLE ON DRILL PRESS TO PRODUCE A FINISHED HOLE TO .001 OF AN INCH

COMMUNICATIONS

1. Reading blueprints to determine:
   - Δ a. Size and characteristics of part
   - Δ b. Size and depth of hole
   - * c. Number of parts to be reamed
   - Δ d. Accuracy required

MEASUREMENT

1. Measuring inside diameter of hole with:
   - * a. Inside micrometer
   - ∅ b. Plug gauge
   - c. Telescope gauge

MATHEMATICS

∅ 1. Determining decimal and fractional equivalents from charts.

∅ 2. Computing decimal equivalents of fractions.

∅ 3. Computing fractional equivalents of decimals.

Δ 4. Applying knowledge of fractional parts of an inch:
   - a. Multiplying fractions to determine exact dimensions
   - b. Adding fractions to determine exact dimensions
   - c. Subtracting fractions to determine exact dimensions
   - d. Dividing fractions to determine exact dimensions

* 5. Applying knowledge of decimals:
   - a. Adding decimals to determine exact dimensions
   - b. Subtracting decimals to determine exact dimensions
   - c. Multiplying decimals to determine exact dimensions
   - d. Dividing decimals to determine exact dimensions

SCIENCE

∅ 1. Explaining the physical properties of the machinability of various metals.

∅ 2. Explaining pulley drive ratios.

ø 3. Explaining heat transfer as it relates to coolants.

SKILLS

1. Mounting reamer in spindle of drill press:

    * a. Straight
    b. Taper shank

ø 2. Adjusting controls to obtain proper spindle speed for reaming.

ø 3. Cleaning machine with cloth and brush to obtain accurate set up.

ø 4. Adjusting depth stop for specific hole depth.

5. Operating drill press to produce finished hole to .001 of an inch.

ø 6. Applying cutting fluids to lubricate cutting action and reduce cutting temperature.

Δ 7. Removing work from holding devices.

8. Removing burrs from finished work with:

    * a. Old drill
    Δ b. Abrasive cloth

INFORMATION

* 1. Selecting proper reamer according to specifications.

ø 2. Selecting (from charts) proper speeds for various materials.

3. Practicing proper safety precautions when operating a drill press:

    * a. Wearing goggles or face shield
    * b. Wearing appropriate apparel
    ø c. Removing all tools before starting machine
    ø d. Making adjustments after machine has stopped
    * e. Using only cutting tools which have been adequately sharpened
    ø f. Maintaining all safety guards in place

ø 4. Removing and disposing of chips to deep work area clear and free from danger.

ø 5. Selecting proper cutting fluids for various metals.

Δ 6. Selecting abrasive cloth for removing burrs.

TASK 16: SPOT FACING A HOLE ON DRILL PRESS TO PRODUCE A FINISHED SURFACE TO .005 OF AN INCH

COMMUNICATIONS

1. Reading blueprints to determine:
    - Δ a. Size and characteristics of part
    - b. Size and depth
    - * c. Number of parts to be spot faced

MEASUREMENT

* 1. Measuring stock with a micrometer to determine size.

MATHEMATICS

ø 1. Determining decimal and fractional equivalents from charts.

ø 2. Computing decimal equivalents of fractions.

Δ 3. Applying knowledge of fractional parts of an inch:

- a. Multiplying fractions to determine exact dimensions
- b. Adding fractions to determine exact dimensions
- c. Subtracting fractions to determine exact dimensions
- d. Dividing fractions to determine exact dimensions

* 4. Applying knowledge of decimals:

- a. Adding decimals to determine exact dimensions
- b. Subtracting decimals to determine exact dimensions
- c. Multiplying decimals to determine exact dimensions
- d. Dividing decimals to determine exact dimensions

SCIENCE

ø 1. Explaining the physical properties of the machinability of various metals.

ø 2. Explaining pulley drive ratios.

ø 3. Explaining heat transfer as it relates to coolants.

SKILLS

1. Mounting spotfacing tool in spindle of drill press.

ø 2. Adjusting controls to obtain proper spindle speed for spot facing.

ø 3. Cleaning machine with cloth and brush to obtain accurate set up.

ø 4. Adjusting depth stop for specific spot face dimension.

ø 5. Centering work with respect to the spindle.

6. Operating drill press to produce a finished surface to .005 of an inch.

ø 7. Applying cutting fluids to lubricate cutting action and reduce cutting temperature.

Δ 8. Removing work from holding devices.

9. Removing burrs from finished work with:

    * a. Old drill
    Δ b. Abrasive cloth
    Δ c. File

INFORMATION

1. Selecting proper spot facing tool.

ø 2. Selecting (from charts) proper speeds for various materials.

3. Practicing proper safety precautions when operating a drill press:

    * a. Wearing goggles or face shield
    * b. Wearing appropriate apparel
    ø c. Removing all tools before starting machine
    ø d. Making adjustments after machine has stopped
    * e. Using only cutting tools which have been adequately sharpened
    ø f. Maintaining all safety guards in place

ø 4. Removing and disposing of chips to keep work area clear and free from danger.

ø 5. Selecting proper cutting fluids for various metals.

Δ 6. Selecting abrasive cloth for removing burrs.

Δ 7. Selecting file for removing burrs.

TASK 17: COUNTERSINKING ON DRILL PRESS TO PRODUCE A FASTENER RECEIVER HOLE

COMMUNICATIONS

1. Reading blueprints to determine:
   - Δ a. Size and characteristics of part
   - b. Size and depth
   - * c. Number of parts to be countersunk
   - Δ d. Accuracy required

SCIENCE

Ø 1. Explaining the physical properties of the machinability of various metals.

Ø 2. Explaining pulley drive ratios.

Ø 3. Explaining heat transfer as it relates to coolants.

SKILLS

1. Mounting countersinking tool in spindle of drill press.

Ø 2. Adjusting controls to obtain proper spindle speed for machining.

Ø 3. Cleaning machine with cloth and brush to obtain accurate set up.

Ø 4. Adjusting depth stop for specific hole depth.

5. Operating drill press to produce a fastener receiver hole.

6. Checking depth of countersink with fastener.

Ø 7. Applying cutting fluids to lubricate cutting action and reduce cutting temperature.

Δ 8. Removing work from holding devices.

9. Removing burrs from finished work with:
   - * a. Old drill
   - Δ b. Abrasive cloth

INFORMATION

* 1. Selecting proper countersinking tool for the task.

ø 2. Selecting (from charts) proper speeds for various materials.

3. Practicing proper safety precautions when operating a drill press:

   * a. Wearing goggles or face shield
   * b. Wearing appropriate apparel
   ø c. Removing all tools before starting machine
   ø d. Making adjustments after machine has stopped
   * e. Using only cutting tools which have been adequately sharpened
   ø f. Maintaining all safety guards in place

ø 4. Removing and disposing of chips to keep work area clear and free from danger.

ø 5. Selecting proper cutting fluids for various metals.

Δ 6. Selecting abrasive cloth for removing burrs.

TASK 18: COUNTERBORING A HOLE ON DRILL PRESS TO PRODUCE AN ENLARGED HOLE TO .005 OF AN INCH

COMMUNICATIONS

1. Reading blueprints to determine:

   Δ a. Size and characteristics of part
   b. Size and depth of hole
   * c. Number of parts to be counterbored
   Δ d. Accuracy required

MEASUREMENT

* 1. Measuring stock with vernier caliper to determine size.

MATHEMATICS

ø 1. Determining decimal and fractional equivalents from charts.

ø 2. Computing decimal equivalents of fractions.

Δ 3. Applying knowledge of fractional parts of an inch:

2

- a. Multiplying fractions to determine exact dimensions
- b. Adding fractions to determine exact dimensions
- c. Subtracting fractions to determine exact dimensions
- d. Dividing fractions to determine exact dimensions

* 4. Applying knowledge of decimals:

- a. Adding decimals to determine exact dimensions
- b. Subtracting decimals to determine exact dimensions
- c. Multiplying decimals to determine exact dimensions
- d. Dividing decimals to determine exact dimensions

SCIENCE

ø 1. Explaining the physical properties of the machinability of various metals.

ø 2. Explaining pulley drive ratios.

ø 3. Explaining heat transfer as it relates to coolants.

SKILLS

1. Mounting counterboring tool in spindle of drill press.

ø 2. Adjusting controls to obtain proper spindle speed for machining.

ø 3. Cleaning machine with cloth and brushes to obtain accurate set up.

ø 4. Adjusting depth stop for specific hole depth.

5. Operating drill press to produce an enlarged hole to .005 of an inch.

ø 6. Applying cutting fluids to lubricate cutting action and reduce cutting temperature.

Δ 7. Removing work from holding devices.

8. Removing burrs from finished work with:

  - * a. Old drill
  - Δ b. Abrasive cloth

INFORMATION

1. Selecting proper counterboring tool for the task.

ø 2. Selecting (from charts) proper speeds for various materials.

3. Practicing proper safety precautions when operating a drill press:
    - * a. Wearing goggles or face shield
    - * b. Wearing appropriate apparel
    - ϕ c. Removing all tools before starting machine
    - ϕ d. Making adjustments after machine has stopped
    - * e. Using only cutting tools which have been adequately sharpened
    - ϕ f. Maintaining all safety guards in place

ϕ 4. Removing and disposing of chips to keep work area clear and free from danger.

ϕ 5. Selecting proper cutting fluids for various metals.

Δ 6. Selecting abrasive cloth for removing burrs.

TASK 19: GRINDING STOCK ON BENCH GRINDER TO REMOVE EXCESS METAL

COMMUNICATIONS

1. Reading blueprints to determine:
    - a. Surfaces to be ground
    - Δ b. Dimensions
    - Δ c. Type finish required

MEASUREMENT

* 1. Measuring stock with vernier calipers to determine size.

* 2. Measuring stock with outside calipers to determine size.

* 3. Measuring stock with outside micrometer to determine size.

SCIENCE

ϕ 1. Explaining the physical properties of the machinability of various metals.

SKILLS

1. Operating a grinder to remove excess metal.

Δ 2. Removing burrs from finished work with:

  a. File
  b. Abrasive cloth

INFORMATION

ø 1. Selecting proper grinding wheel appropriate for finish called for from working drawing.

Δ 2. Selecting abrasive cloth for removing burrs.

3. Practicing proper safety precautions when operating shaper:
   * a. Wearing goggles or face shield
   * b. Wearing appropriate apparel
   ø c. Removing all tools before starting machine
   ø d. Making adjustments after machine has stopped
   * e. Using only cutting tools which have been adequately sharpened
   ø f. Maintaining all safety guards in place

TASK 20: GRINDING TOOLS ON BENCH GRINDER TO SHARPEN

COMMUNICATIONS

1. Reading working drawing, blueprint, or text to determine angles tools are to be sharpened to.

MEASUREMENT

1. Checking drill angles with a drill gauge.

2. Checking angle of center punch with center gauge.

MATHEMATIC

ø 1. Applying knowledge of angles.

SKILLS

1. Grinding scriber to correct point.

2. Mounting drill in drill bit attachment.

3. Grinding drill bits to specified angles and clearances.

4. Grinding lathe tools on grinder to correct angles and clearances.

5. Grinding various shaped chisels on a grinder to correct angles.

6. Grinding center punch to correct angle.

INFORMATION

1. Applying knowledge of cutting angles for specific materials.

TASK 21: GRINDING STOCK ON SURFACE GRINDER TO PRODUCE A FLAT SURFACE

COMMUNICATIONS

1. Reading blueprint to determine:

   Δ a. Size and characteristics of the workpiece
   Δ b. Type of operation
   Δ c. Finish and accuracy required
   * d. Number of parts
   Δ e. Kind of material

MEASUREMENT

ø 1. Reading graduation on vertical adjustment hand wheel.

MATHEMATICS

* 1. Applying knowledge of decimals:

   a. Adding decimals to determine exact dimensions
   b. Subtracting decimals to determine exact dimensions
   c. Multiplying decimals to determine exact dimensions
   d. Dividing decimals to determine exact dimensions

SCIENCE

ø 1. Explaining the physical properties of the machinability of various metals.

ø 2. Explaining heat transfer as it relates to coolants.

SKILLS

ϕ 1. Testing soundness of wheel by striking a light blow with a hammer.

ϕ 2. Mounting grinding wheel on spindle of surface grinder.

ϕ 3. Truing and dressing a grinding wheel with a truing fixture.

4. Mounting work on surface grinder with:

    Δ a. Vise
    Δ b. Clamps
    ϕ c. Magnetic surface

ϕ 5. Mounting stock with:

    a. Parallels
    b. Angle plate
    c. Vee block
    d. Shims
    e. Step block

ϕ 6. Aligning grinding wheel with work to be ground.

ϕ 7. Setting depth of cut for roughing cut.

8. Operating surface grinder to produce a flat surface.

ϕ 9. Adjusting power cross feed for automatic operation.

ϕ 10. Applying cutting fluid to lubricate grinding action and reduce cutting temperature.

ϕ 11. Setting depth of cut for finishing cut.

Δ 12. Removing work from mounting device.

Δ 13. Removing burrs from finished work with:

    a. File
    b. Abrasive cloth

INFORMATION

ϕ 1. Selecting a grinding wheel appropriate for task.

2. Selecting method of holding work to be machined:

    Δ a. Vise
    Δ b. Clamps
    ϕ c. Magnetic surface

ø 3. Selecting appropriate cutting fluids for grinding.

ø 4. Selecting proper longitudinal and cross feeds for grinder.

5. Practicing proper safety precautions when operating a surface grinder:
    - * a. Wearing goggles or face shield
    - * b. Wearing appropriate apparel
    - ø c. Removing all tools before starting machine
    - ø d. Making adjustments after machine has stopped
    - * e. Using only grinding wheels which have been trued and dressed
    - ø f. Maintaining all safety guards in place

Δ 6. Selecting proper type of file.

TASK 22: GRINDING STOCK ON SURFACE GRINDER TO PRODUCE TWO PARALLEL SURFACES TO .001 OF AN INCH

COMMUNICATIONS

1. Reading blueprint to determine:
    - Δ a. Size and characteristics of the workpiece
    - Δ b. Type of operation
    - Δ c. Finish and accuracy required
    - * d. Number of parts
    - Δ e. Kind of material

MEASUREMENT

ø 1. Reading graduations on vertical adjustment hand wheel.

* 2. Measuring stock with a micrometer to determine size.

MATHEMATICS

* 1. Applying knowledge of decimals:
    - a. Adding decimals to determine exact dimensions
    - b. Subtracting decimals to determine exact dimensions
    - c. Multiplying decimals to determine exact dimensions
    - d. Dividing decimals to determine exact dimensions

SCIENCE

ϕ 1. Explaining the physical properties of the machinability of various metals.

ϕ 2. Explaining heat transfer as it relates to coolants.

SKILLS

1. Mounting work on surface grinder with:

    Δ a. Vise
    Δ b. Clamps
    ϕ c. Magnetic surface

ϕ 2. Mounting stock with:

    a. Parallels
    b. Angle plate
    c. Vee block
    d. Shims
    e. Step block

ϕ 3. Aligning grinding wheel with work to be ground.

ϕ 4. Setting depth of cut for roughing cut.

5. Operating surface grinder to produce two parallel surfaces to .001 of an inch.

ϕ 6. Adjusting power cross feed for automatic operation.

ϕ 7. Applying cutting fluid to lubricate grinding action and reduce cutting temperature.

ϕ 8. Setting depth of cut for finishing cut.

Δ 9. Removing work from mounting device.

Δ 10. Removing burrs from finished work with:

    a. File
    b. Abrasive cloth

INFORMATION

1. Practicing proper safety precautions when operating a surface grinder:

    * a. Wearing goggles or face shield
    * b. Wearing appropriate apparel
    ϕ c. Removing all tools before starting machine

- ∅ d. Making adjustments after machine has stopped
- * e. Using only grinding wheels which have been trued and dressed
- ∅ f. Maintaining all safety guards in place

Δ 2. Selecting proper type of file

TASK 23: GRINDING STOCK ON SURFACE GRINDER TO PRODUCE TWO PERPENDICULAR SURFACES TO .001 OF AN INCH

COMMUNICATIONS

1. Reading blueprint to determine:

   - Δ a. Size and characteristics of the workpiece
   - Δ b. Type of operation
   - Δ c. Finish and accuracy required
   - * d. Number of parts
   - Δ e. Kind of material

MEASUREMENT

∅ 1. Reading graduations on vertical adjustment hand wheel.

* 2. Measuring stock with a micrometer to determine size.

MATHEMATICS

* 1. Applying knowledge of decimals:

   - a. Adding decimals to determine exact dimensions
   - b. Subtracting decimals to determine exact dimensions
   - c. Multiplying decimals to determine exact dimensions
   - d. Dividing decimals to determine exact dimensions

SCIENCE

∅ 1. Explaining the physical properties of the machinability of various metals.

∅ 2. Explaining heat transfer as it relates to coolants.

SKILLS

∅ 1. Testing soundness of wheel by striking a light blow with a hammer.

ø 2. Mounting grinding wheel on spindle of surface grinder.

ø 3. Truing and dressing a grinding wheel with a truing fixture.

4. Mounting work on surface grinder with:

   Δ a. Vise
   Δ b. Clamps
   ø c. Magnetic surface

ø 5. Mounting stock with:

   a. Parallels
   b. Angle plate
   c. Vee block
   d. Shims
   e. Step block

ø 6. Aligning grinding wheel with work to be ground.

ø 7. Setting depth of cut for roughing cut.

8. Operating surface grinder to produce a flat surface.

ø 9. Adjusting power cross feed for automatic operation.

ø 10. Applying cutting fluid to lubricate grinding action and reduce cutting temperature.

ø 11. Setting depth of cut for finishing cut.

Δ 12. Removing work from mounting device.

Δ 13. Removing burrs from finished work with:

   a. File
   b. Abrasive cloth

INFORMATION

ø 1. Selecting a grinding wheel appropriate for task.

2. Selecting method of holding work to be machined:

   Δ a. Vise
   Δ b. Clamps
   ø c. Magnetic surface

ø 3. Selecting appropriate cutting fluids for grinding.

ø 4. Selecting proper longitudinal and cross feeds for grinder.

5. Practicing proper safety precautions when operating a surface grinder:
    * a. Wearing goggles or face shield
    * b. Wearing appropriate apparel
    ∅ c. Removing all tools before starting machine
    ∅ d. Making adjustments after machine has stopped
    * e. Using only grinding wheels which have been trued and dressed
    ∅ f. Maintaining all safety guards in place

Δ 6. Selecting proper type of file.

TASK 24: GRINDING STOCK ON SURFACE GRINDER TO PRODUCE AN ANGULAR SURFACE

COMMUNICATIONS

1. Reading blueprint to determine:
    Δ a. Size and characteristics of the workpiece
    Δ b. Type of operation
    Δ c. Finish and accuracy required
    * d. Number of parts
    Δ e. Kind of material

MEASUREMENT

∅ 1. Reading graduations on vertical adjustment hand wheel.

∅ 2. Measuring angular surfaces with a sine bar to determine angle.

MATHEMATICS

* 1. Applying knowledge of decimals:
    a. Adding decimals to determine exact dimensions
    b. Subtracting decimals to determine exact dimensions
    c. Multiplying decimals to determine exact dimensions
    d. Dividing decimals to determine exact dimensions

∅ 2. Applying a knowledge of angles.

SCIENCE

∅ 1. Explaining the physical properties of the machinability of various metals.

ø 2. Explaining heat transfer as it relates to coolants.

SKILLS

ø 1. Testing soundness of wheel by striking a light blow with a hammer.

ø 2. Mounting grinding wheel on spindle of surface grinder.

ø 3. Truing and dressing a grinding wheel with a truing fixture.

4. Mounting work on surface grinder with:

    Δ a. Vise
    Δ b. Clamps
    ø c. Magnetic surface

ø 5. Mounting stock with:

    a. Parallels
    b. Angle plate
    c. Vee block
    d. Shims
    e. Step block

ø 6. Aligning grinding wheel with work to be ground.

ø 7. Setting depth of cut for roughing cut.

8. Operating surface grinder to produce a flat surface.

ø 9. Adjusting power cross feed for automatic operation.

ø 10. Applying cutting fluid to lubricate grinding action and reduce cutting temperature.

ø 11. Setting depth of cut for finishing cut.

Δ 12. Removing work from mounting device.

Δ 13. Removing burrs from finished work with:

    a. File
    b. Abrasive cloth

INFORMATION

ø 1. Selecting a grinding wheel appropriate for task.

2. Selecting method of holding work to be machined:

Δ a. Vise
Δ b. Clamps
ϕ c. Magnetic surface

ϕ 3. Selecting appropriate cutting fluids for grinding.

ϕ 4. Selecting proper longitudinal and cross feeds for grinder.

5. Practicing proper safety precautions when operating a surface grinder:

   * a. Wearing goggles or face shield
   * b. Wearing appropriate apparel
   ϕ c. Removing all tools before starting machine
   ϕ d. Making adjustments after machine has stopped
   * e. Using only grinding wheels which have been trued and dressed
   ϕ f. Maintaining all safety guards in place

Δ 6. Selecting proper type of file.

TASK 25: MACHINING STOCK ON A HORIZONTAL MILLING MACHINE TO PRODUCE A FLAT SURFACE

COMMUNICATIONS

1. Reading blueprint to determine:

   Δ a. Size and characteristics of the workpiece
   Δ b. Type of operation
   Δ c. Finish and accuracy required
   * d. Number of parts
   Δ e. Kind of material

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

ϕ 2. Computing spindle speed and feed according to type of material being machined.

SCIENCE

ϕ 1. Explaining the physical properties of the machinability of various metals.

ϕ 2. Explaining gear drive ratios.

ϕ 3. Explaining heat transfer as it relates to coolants.

SKILLS

Δ 1. Laying out stock with a rule and scriber.

* 2. Cutting stock to length with:

- a. Hand saw
- b. Power hack saw
- c. Power band saw

3. Mounting holding devices on milling machine:

- Δ a. Vises
- Δ b. Clamps
- ϕ c. Jigs and fixtures

ϕ 4. Cleaning machine with rag and brush to obtain accurate set up.

ϕ 5. Mounting stock with:

- a. Parallels
- b. Angle plate
- c. Shims
- d. Step block

ϕ 6. Mounting cutters, spacing and bearing collars on milling machine spindle.

ϕ 7. Adjusting controls to obtain proper speeds for various cutters and metals to be machined.

ϕ 8. Adjusting controls to obtain proper feeds for various cutters and materials.

ϕ 9. Aligning cutter with stock to be machined.

10. Operating a horizontal milling machine to produce a flat surface.

ϕ 11. Applying cutting fluids to lubricate cutting action and reduce cutting temperature.

Δ 12. Removing stock from holding devices.

Δ 13. Removing burrs from finished work with:

- a. File
- b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tools for the task.

* 2. Selecting appropriate hacksaw blades for the task.

3. Selecting proper method for holding stock to be machined:

   ∅ a. Jigs and fixtures
   Δ b. Vise
   ∅ c. Angle plates
   Δ d. Clamps

∅ 4. Selecting proper cutter for specific operation:

   a. Slab
   b. Helical tooth
   c. Form relieved
   d. Inserted tooth, stagger tooth, side

∅ 5. Selecting (from charts) proper speeds and feeds for various cutters and materials.

∅ 6. Selecting proper feeds for various cutters and materials.

∅ 7. Selecting direction of cut.

∅ 8. Removing and disposing of chips to keep work area clear and free from danger.

9. Practicing proper safety precautions when operating a horizontal milling machine:

   * a. Wearing goggles or face shield
   * b. Wearing appropriate apparel
   ∅ c. Removing all tools before starting machine
   ∅ d. Making adjustments after machine has stopped
   * e. Using only cutting tools which have been adequately sharpened
   ∅ f. Maintaining all safety guards in place

∅ 10. Selecting proper cutting fluids for various metals.

Δ 11. Selecting proper type of file.

Δ 12. Selecting abrasive cloth for removing burrs.

TASK 26: MACHINING STOCK ON A HORIZONTAL MILLING MACHINE TO PRODUCE PARALLEL SURFACES TO .005 OF AN INCH

COMMUNICATIONS

1. Reading blueprint to determine:
    - Δ a. Size and characteristics of the workpiece
    - Δ b. Type of operation
    - Δ c. Finish and accuracy required
    - * d. Number of parts
    - Δ e. Kind of material

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

* 2. Measuring stock with a micrometer to determine size.

* 3. Measuring stock with a vernier caliper to determine size.

ø 4. Reading graduations on vertical feed.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

- a. Multiplying fractions to determine exact dimensions
- b. Adding fractions to determine exact dimensions
- c. Subtracting fractions to determine exact dimensions
- d. Dividing fractions to determine exact dimensions

* 2. Applying knowledge of decimals:

- a. Adding decimals to determine exact dimensions
- b. Subtracting decimals to determine exact dimensions
- c. Multiplying decimals to determine exact dimensions
- d. Dividing decimals to determine exact dimensions

ø 3. Computing spindle speed and feed according to type of material being machined.

ø 4. Determining fractional and decimal equivalents from charts.

ø 5. Computing fractional equivalents of decimals.

ø 6. Computing decimal equivalents of fractions.

SCIENCE

ø 1. Explaining the physical properties of the machinability of various metals.

ɸ 2. Explaining gear drive ratios.

ɸ 3. Explaining heat transfer as it relates to coolants.

SKILLS

1. Laying out stock with a:

    Δ a. Square
    Δ b. Rule or scale
    * c. Surface gauge and plate
    Δ d. Dividers
    Δ e. Scriber
    ɸ f. Vernier height gauge

ɸ 2. Cleaning machine with rag and brush to obtain accurate set up.

ɸ 3. Mounting stock with:

    a. Parallels
    b. Angle plate
    c. Vee block
    d. Shims
    e. Step block

ɸ 4. Aligning cutter with stock to be machined.

5. Operating horizontal milling machine to produce parallel surfaces to .005 of an inch.

ɸ 6. Applying cutting fluids to lubricate cutting action and reduce cutting temperature.

Δ 7. Removing stock from holding devices.

Δ 8. Removing burrs from finished work with:

    a. File
    b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tools for the task.

ø 2. Removing and disposing of chips to keep work area clear and free from danger.

3. Practicing proper safety precautions when operating a horizontal milling machine:

    * a. Wearing goggles or face shield

- * b. Wearing appropriate apparel
- ϕ c. Removing all tools before starting machine
- ϕ d. Making adjustments after machine has stopped
- * e. Using only cutting tools which have been adequately sharpened
- ϕ f. Maintaining all safety guards in place

Δ 4. Selecting proper type of file.

Δ 5. Selecting abrasive cloth for removing burrs.

TASK 27: MACHINING STOCK ON A HORIZONTAL MILLING MACHINE TO PRODUCE TWO PERPENDICULAR SURFACES TO .001 OF AN INCH

COMMUNICATIONS

1. Reading blueprint to determine:

    - Δ a. Size and characteristics of the workpiece
    - Δ b. Type of operation
    - Δ c. Finish and accuracy required
    - * d. Number of parts
    - Δ e. Kind of material

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

* 2. Measuring stock with a micrometer to determine size.

* 3. Measuring stock with a vernier caliper to determine size.

ϕ 4. Reading graduations on vertical feed to determine size.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

- a. Multiplying fractions to determine exact dimensions
- b. Adding fractions to determine exact dimensions
- c. Subtracting fractions to determine exact dimensions
- d. Dividing fractions to determine exact dimensions

* 2. Applying knowledge of decimals:

- a. Adding decimals to determine exact dimensions
- b. Subtracting decimals to determine exact dimensions
- c. Multiplying decimals to determine exact dimensions
- d. Dividing decimals to determine exact dimensions

ϕ 3. Computing spindle speed and feed according to type of material being machined.

ϕ 4. Determining fractional and decimal equivalents from charts.

ϕ 5. Computing fractional equivalents of decimals.

ϕ 6. Computing decimal equivalents of fractions.

SCIENCE

ϕ 1. Explaining the physical properties of the machinability of various metals.

ϕ 2. Explaining gear drive ratios.

ϕ 3. Explaining heat transfer as it relates to coolants.

SKILLS

1. Laying out stock with a:
    - Δ a. Square
    - Δ b. Rule or scale
    - * c. Surface gauge and plate
    - Δ d. Dividers
    - Δ e. Scriber
    - ϕ f. Vernier height gauge

* 2. Cutting stock to length with:
    - a. Hand saw
    - b. Power hack saw
    - c. Power band saw

3. Mounting holding devices on milling machine:
    - Δ a. Vises
    - Δ b. Clamps
    - ϕ c. Jigs and fixtures

ϕ 4. Cleaning machine with rag and brush to obtain accurate set up.

ϕ 5. Mounting stock with:
    - a. Parallels
    - b. Angle plate
    - c. Vee block
    - d. Shims
    - e. Step block

ø 6. Mounting cutters, spacing and bearing collars on milling machine spindle.

ø 7. Adjusting controls to obtain proper speeds for various cutters and metals to be machined.

ø 8. Adjusting controls to obtain proper feeds for various cutters and materials.

ø 9. Aligning cutter with stock to be machined.

•10. Operating horizontal milling machine to produce two perpendicular surfaces to .005 of an inch.

ø 11. Applying cutting fluids to lubricate cutting action and reduce cutting temperature.

Δ 12. Removing stock from holding devices.

Δ 13. Removing burrs from finished work with:

a. File
b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tools for the task.

* 2. Selecting appropriate hacksaw blades for the task.

3. Selecting proper method for holding stock to be machined:

ø a. Jigs and fixtures
Δ b. Vise
ø c. Angle plates
Δ d. Clamps

ø 4. Selecting proper cutter for specific operation:

a. Slab
b. Helical tooth
c. Form relieved
d. Inserted tooth, stagger tooth, side

ø 5. Selecting (from charts) proper speeds and feeds for various cutters and materials.

ø 6. Selecting proper feeds for various cutters and materials.

ø 7. Selecting direction of cut.

ø 8. Removing and disposing of chips to keep work area clear and free from danger.

9. Practicing proper safety precautions when operating a horizontal milling machine:
    - * a. Wearing goggles or face shield
    - * b. Wearing appropriate apparel
    - ϕ c. Removing all tools before starting machine
    - ϕ d. Making adjustments after machine has stopped
    - * e. Using only cutting tools which have been adequately sharpened
    - ϕ f. Maintaining all safety guards in place

ϕ 10. Selecting proper cutting fluids for various metals.

Δ 11. Selecting proper type of file.

Δ 12. Selecting abrasive cloth for removing burrs.

TASK 28: MACHINING STOCK ON A HORIZONTAL MILLING MACHINE TO PRODUCE A SHOULDER TO .001 OF AN INCH

COMMUNICATIONS

1. Reading blueprint to determine:
    - Δ a. Size and characteristics of the workpiece
    - Δ b. Type of operation
    - Δ c. Finish and accuracy required
    - * d. Number of parts
    - Δ e. Kind of material

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

* 2. Measuring stock with a micrometer to determine size.

* 3. Measuring stock with a vernier caliper to determine size.

ϕ 4. Reading graduations on vertical feed.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:
    - a. Multiplying fractions to determine exact dimensions
    - b. Adding fractions to determine exact dimensions
    - c. Subtracting fractions to determine exact dimensions
    - d. Dividing fractions to determine exact dimensions

* 2. Applying knowledge of decimals:

   a. Adding decimals to determine exact dimensions
   b. Subtracting decimals to determine exact dimensions
   c. Multiplying decimals to determine exact dimensions
   d. Dividing decimals to determine exact dimensions

ø 3. Computing spindle speed and feed according to type of material being machined.

ø 4. Determining fractional and decimal equivalents from charts.

ø 5. Computing fractional equivalents of decimals.

ø 6. Computing decimal equivalents of fractions.

SCIENCE

ø 1. Explaining the physical properties of the machinability of various metals.

ø 2. Explaining gear drive ratios.

ø 3. Explaining heat transfer as it relates to coolants.

SKILLS

1. Laying out stock with a:

   Δ a. Square
   Δ b. Rule or scale
   * c. Surface gauge and plate
   Δ d. Dividers
   Δ e. Scriber
   ø f. Vernier height gauge

* 2. Cutting stock to length with:

   a. Hand saw
   b. Power hack saw
   c. Power band saw

3. Mounting holding devices on milling machine:

   Δ a. Vises
   Δ b. Clamps
   ø c. Jigs and fixtures

ø 4. Cleaning machine with rag and brush to obtain accurate set up ø 5. Mounting stock with:

  a. Parallels
  b. Angle plate
  c. Vee block
  d. Shims
  e. Step block

ø 6. Mounting cutters, spacing and bearing collars on milling machine spindle.

ø 7. Adjusting controls to obtain proper speeds for various cutters and metals to be machined.

ø 8. Adjusting controls to obtain proper feeds for various cutters and materials.

ø 9. Aligning cutter with stock to be machined.

10. Operating horizontal milling machine to produce a shoulder to .005 of an inch.

ø 11. Applying cutting fluids to lubricate cutting action and reduce cutting temperature.

Δ 12. Removing stock from holding devices.

Δ 13. Removing burrs from finished work with:

  a. File
  b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tools for the task.

* 2. Selecting appropriate hacksaw blades for the task.

3. Selecting proper method for holding stock to be machined:

  ø a. Jigs and fixtures
  Δ b. Vise
  ø c. Angle plates
  Δ d. Clamps

ø 4. Selecting proper cutter for specific operation:

  a. Slab
  b. Helical tooth
  c. Form relieved
  d. Inserted tooth, stagger tooth, side

ϕ 5. Selecting (from charts) proper speeds and feeds for various cutters and materials.

ϕ 6. Selecting proper feeds for various cutters and materials.

ϕ 7. Selecting direction of cut.

ϕ 8. Removing and disposing of chips to keep work area clear and free from danger.

9. Practicing proper safety precautions when operating a horizontal milling machine:

   * a. Wearing goggles or face shield
   * b. Wearing appropriate apparel
   ϕ c. Removing all tools before starting machine
   ϕ d. Making adjustments after machine has stopped
   * e. Using only cutting tools which have been adequately sharpened
   ϕ f. Maintaining all safety guards in place

ϕ 10. Selecting proper cutting fluids for various metals.

Δ 11. Selecting proper type of file.

Δ 12. Selecting abrasive cloth for removing burrs.

TASK 29: MACHINING STOCK ON A HORIZONTAL MILLING MACHINE TO PRODUCE AN ANGULAR SURFACE

COMMUNICATIONS

1. Reading blueprint to determine:

   Δ a. Size and characteristics of the workpiece
   Δ b. Type of operation
   Δ c. Finish and accuracy required
   * d. Number of parts
   Δ e. Kind of material

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

ϕ 2. Measuring angular surfaces with a sine bar.

MATHEMATICS

- Δ 1. Applying knowledge of fractional parts of an inch:
  - a. Multiplying fractions to determine exact dimensions
  - b. Adding fractions to determine exact dimensions
  - c. Subtracting fractions to determine exact dimensions
  - d. Dividing fractions to determine exact dimensions
- ϕ 2. Computing spindle speed and feed accoring to type of material being machined.
- ϕ 3. Applying knowledge of angles.

SCIENCE

- ϕ 1. Explaining the physical properties of the machinability of various metals.
- ϕ 2. Explaining gear drive ratios.
- ϕ 3. Explaining heat transfer as it relates to coolants.

SKILLS

- 1. Laying out stock with a:
  - Δ a. Square
  - Δ b. Rule or scale
  - * c. Combination square
  - * d. Surface gauge and plate
  - Δ e. Scriber
  - ϕ f. Vernier height gauge
- * 2. Cutting stock to length with:
  - a. Hand saw
  - b. Power hack saw
  - c. Power band saw
- 3. Mounting holding devices on milling machine:
  - Δ a. Vises
  - Δ b. Clamps
  - ϕ c. Jigs and fixtures
- ϕ 4. Cleaning machine with rag and brush to obtain accurate set up.
- ϕ 5. Mounting stock with:
  - a. Parallels

        b. Angle plate
        c. Vee block
        d. Shims
        e. Step block

ϕ 6. Mounting cutters, spacing and bearing collars on milling machine spindle.

ϕ 7. Adjusting controls to obtain proper speeds for various cutters and metals to be machined.

ϕ 8. Adjusting controls to obtain proper feeds for various cutters and materials.

ϕ 9. Aligning cutter with stock to be machined.

10. Operating horizontal milling machine to produce a flat surface.

ϕ 11. Applying cutting fluids to lubricate cutting action and reduce cutting temperature.

Δ 12. Removing stock from holding devices.

Δ 13. Removing burrs from finished work with:

        a. File
        b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tools for the task.

* 2. Selecting appropriate hacksaw blades for the task.

3. Selecting proper method for holding stock to be machined:

    ϕ a. Jigs and fixtures
    Δ b. Vise
    ϕ c. Angle plates
    Δ d. Clamps

ϕ 4. Selecting proper cutter for specific operation:

        a. Slab
        b. Helical tooth
        c. Form relieved
        d. Inserted tooth, stagger tooth, side

ϕ 5. Selecting (from charts) proper speeds and feeds for various cutters and materials.

ϕ 6. Selecting proper feeds for various cutters and materials.

Ø 7. Selecting direction of cut.

Ø 8. Removing and disposing of chips to keep work area clear and free from danger.

9. Practicing proper safety precautions when operating a horizontal milling machine:

    * a. Wearing goggles or face shield
    * b. Wearing appropriate apparel
    Ø c. Removing all tools before starting machine
    Ø d. Making adjustments after machine has stopped
    * e. Using only cutting tools which have been adequately sharpened
    Ø f. Maintaining all safety guards in place

Ø 10. Selecting proper cutting fluids for various metals.

Δ 11. Selecting proper type of file.

Δ 12. Selecting abrasive cloth for removing burrs.

TASK 30: MACHINING STOCK ON A VERTICAL MILLING MACHINE TO PRODUCE A FLAT SURFACE

COMMUNICATIONS

1. Reading blueprint to determine:

    Δ a. Size and characteristics of the workpiece
    Δ b. Type of operation
    Δ c. Finish and accuracy required
    * d. Number of parts
    Δ e. Kind of material

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

    a. Multiplying fractions to determine exact dimensions
    b. Adding fractions to determine exact dimensions
    c. Subtracting fractions to determine exact dimensions
    d. Dividing fractions to determine exact dimensions

ϕ 2. Computing spindle speed and feed according to type of material being machined.

ϕ 3. Determining fractional and decimal equivalents from charts.

ϕ 4. Computing fractional and decimal equivalents.

SCIENCE

ϕ 1. Explaining the physical properties of the machinability of various metals.

ϕ 2. Explaining gear drive ratios.

ϕ 3. Explaining heat transfer as it relates to coolants.

SKILLS

Δ 1. Laying out stock with a:

- a. Square
- b. Rule or scale
- c. Dividers
- d. Scriber

* 2. Cutting stock to length with:

- a. Hand saw
- b. Power hack saw
- c. Power band saw

3. Mounting holding devices on milling machine:

- Δ a. Vises
- Δ b. Clamps
- ϕ c. Jigs and fixtures

ϕ 4. Cleaning machine with rag and brush to obtain accurate set up.

ϕ 5. Mounting stock with:

- a. Parallels
- b. Angle plate
- c. Vee block
- d. Shims
- e. Step block

ϕ 6. Mounting cutters, spacing and bearing collars on milling machine spindle.

ϕ 7. Adjusting controls to obtain proper speeds for various cutters and metals to be machined.

ϕ 8. Adjusting controls to obtain proper feeds for various cutters and materials.

ϕ 9. Aligning cutter with stock to be machined.

10. Operating a vertical milling machine to produce a flat surface.

ϕ 11. Applying cutting fluids to lubricate cutting action and reduce cutting temperature.

Δ 12. Removing stock from holding devices.

Δ 13. Removing burrs from finished work with:

    a. File
    b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tools for the task.

* 2. Selecting appropriate hacksaw blades for the task.

3. Selecting proper method for holding stock to be machined:

    ϕ a. Jigs and fixtures
    Δ b. Vise
    ϕ c. Angle plates
    Δ d. Clamps

ϕ 4. Selecting proper cutter for specific operation:

    a. Slab
    b. Helical tooth
    c. Form relieved
    d. Inserted tooth, stagger tooth, side

ϕ 5. Selecting (from charts) proper speeds and feeds for various cutters and materials.

ϕ 6. Selecting proper feeds for various cutters and materials.

ϕ 7. Selecting direction of cut.

ϕ 8. Removing and disposing of chips to keep work area clear and free from danger.

9. Practicing proper safety precautions when operating a horizontal milling machine:

- * a. Wearing goggles or face shield
- * b. Wearing appropriate apparel
- ϕ c. Removing all tools before starting machine
- ϕ d. Making adjustments after machine has stopped
- * e. Using only cutting tools which have been adequately sharpened
- ϕ f. Maintaining all safety guards in place

ϕ 10. Selecting proper cutting fluids for various metals.

Δ 11. Selecting proper type of file.

Δ 12. Selecting abrasive cloth for removing burrs.

TASK 31: MACHINING STOCK ON A VERTICAL MILLING MACHINE TO PRODUCE TWO PARALLEL SURFACES TO .001 OF AN INCH

COMMUNICATIONS

1. Reading blueprint to determine:
    - Δ a. Size and characteristics of the workpiece
    - Δ b. Type of operation
    - Δ c. Finish and accuracy required
    - * d. Number of parts
    - Δ e. Kind of material

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

* 2. Measuring stock with a micrometer to determine size.

* 3. Measuring stock with a vernier caliper to determine size.

ϕ 4. Reading graduations on vertical feed.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

- a. Multiplying fractions to determine exact dimensions
- b. Adding fractions to determine exact dimensions
- c. Subtracting fractions to determine exact dimensions
- d. Dividing fractions to determine exact dimensions

* 2. Applying knowledge of decimals:

   a. Adding decimals to determine exact dimensions
   b. Subtracting decimals to determine exact dimensions
   c. Multiplying decimals to determine exact dimensions
   d. Dividing decimals to determine exact dimensions

ϕ 3. Computing spindle speed and feed according to type of material being machined.

ϕ 4. Determining fractional and decimal equivalents from charts.

ϕ 5. Computing fractional equivalents of decimals.

ϕ 6. Computing decimal equivalents of fractions.

SCIENCE

ϕ 1. Explaining the physical properties of the machinability of various metals.

ϕ 2. Explaining gear drive ratios.

ϕ 3. Explaining heat transfer as it relates to coolants.

SKILLS

1. Laying out stock with a:

   Δ a. Square
   Δ b. Rule or scale
   * c. Surface gauge and plate
   Δ d. Dividers
   Δ e. Scriber
   ϕ f. Vernier height gauge

ϕ 2. Cleaning machine with rag and brush to obtain accurate set up.

ϕ 3. Mounting stock with:

   a. Parallels
   b. Angle plate
   c. Vee block
   d. Shims
   e. Step block

ϕ 4. Aligning cutter with stock to be machined.

5. Operating a vertical milling machine to produce parallel surfaces to .005 of an inch.

ø 6. Applying cutting fluids to lubricate cutting action and reduce cutting temperature.

Δ 7. Removing stock from holding devices.

Δ 8. Removing burrs from finished work with:

  a. File
  b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tools for the task.

ø 2. Removing and disposing of chips to keep work area clear and free from danger.

3. Practicing proper safety precautions when operating a horizontal milling machine:

  * a. Wearing goggles or face shield
  * b. Wearing appropriate apparel
  ø c. Removing all tools before starting machine
  ø d. Making adjustments after machine has stopped
  * e. Using only cutting tools which have been adequately sharpened
  ø f. Maintaining all safety guards in place

Δ 4. Selecting proper type of file.

Δ 5. Selecting abrasive cloth for removing burrs.

TASK 32: MACHINING STOCK ON A VERTICAL MILLING MACHINE TO PRODUCE TWO PERPENDICULAR SURFACES TO .001 OF AN INCH

COMMUNICATIONS

1. Reading blueprint to determine:

  Δ a. Size and characteristics of the workpiece
  Δ b. Type of operation
  Δ c. Finish and accuracy required
  * d. Number of parts
  Δ e. Kind of material

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

* 2. Measuring stock with a micrometer to determine size.

* 3. Measuring stock with a vernier caliper to determine size.

ø 4. Reading graduations on vertical feed.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

    a. Multiplying fractions to determine exact dimensions
    b. Adding fractions to determine exact dimensions
    c. Subtracting fractions to determine exact dimensions
    d. Dividing fractions to determine exact dimensions

* 2. Applying knowledge of decimals:

    a. Adding decimals to determine exact dimensions
    b. Subtracting decimals to determine exact dimensions
    c. Multiplying decimals to determine exact dimensions
    d. Dividing decimals to determine exact dimensions

ø 3. Computing spindle speed and feed according to type of material being machined.

ø 4. Determining fractional and decimal equivalents from charts.

ø 5. Computing fractional equivalents of decimals.

ø 6. Computing decimal equivalents of fractions.

SCIENCE

ø 1. Explaining the physical properties of the machinability of various metals.

ø 2. Explaining gear drive ratios.

ø 3. Explaining heat transfer as it relates to coolants.

SKILLS

1. Laying out stock with a:

    Δ a. Square
    Δ b. Rule or scale
    * c. Surface gauge and plate
    Δ d. Dividers
    Δ e. Scriber
    ø f. Vernier height gauge

* 2. Cutting stock to length with:

    a. Hand saw
    b. Power hack saw
    c. Power band saw

3. Mounting holding devices on milling machine:

    Δ a. Vises
    Δ b. Clamps
    ∅ c. Jigs and fixtures

∅ 4. Cleaning machine with rag and brush to obtain accurate set up.

∅ 5. Mounting stock with:

    a. Parallels
    b. Angle plate
    c. Vee block
    d. Shims
    e. Step block

∅ 6. Mounting cutters, spacing and bearing collars on milling machine spindle.

∅ 7. Adjusting controls to obtain proper speeds for various cutters and metals to be machined.

∅ 8. Adjusting controls to obtain proper feeds for various cutters and materials.

∅ 9. Aligning cutter with stock to be machined.

10. Operating vertical milling machine to produce two perpendicular surfaces to .005 of an inch.

∅ 11. Applying cutting fluids to lubricate cutting action and reduce cutting temperature.

Δ 12. Removing stock from holding devices.

Δ 13. Removing burrs from finished work with:

    a. File
    b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tools for the task.

* 2. Selecting appropriate hacksaw blades for the task.

3. Selecting proper method for holding stock to be machined:

    ϕ a. Jigs and fixtures
    Δ b. Vise
    ϕ c. Angle plates
    Δ d. Clamps

ϕ 4. Selecting proper cutter for specific operation:

    a. Slab
    b. Helical tooth
    c. Form relieved
    d. Inserted tooth, stagger tooth, side

ϕ 5. Selecting (from charts) proper speeds and feeds for various cutters and materials.

ϕ 6. Selecting proper feeds for various cutters and materials.

ϕ 7. Selecting direction of cut.

ϕ 8. Removing and disposing of chips to keep work area clear and free from danger.

9. Practicing proper safety precautions when operating a horizontal milling machine:

    * a. Wearing goggles or face shield
    * b. Wearing appropriate apparel
    ϕ c. Removing all tools before starting machine
    ϕ d. Making adjustments after machine has stopped
    * e. Using only cutting tools which have been adequately sharpened
    ϕ f. Maintaining all safety guards in place

ϕ 10. Selecting proper cutting fluids for various metals.

Δ 11. Selecting proper type of file.

Δ 12. Selecting abrasive cloth for removing burrs.

TASK 33: MACHINING STOCK ON A VERTICAL MILLING MACHINE TO PRODUCE A SHOULDER TO .001 OF AN INCH

COMMUNICATIONS

1. Reading blueprint to determine:

    Δ a. Size and characteristics of the workpiece
    Δ b. Type of operation

- Δ c. Finish and accuracy required
- * d. Number of parts
- Δ e. Kind of material

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

* 2. Measuring stock with a micrometer to determine size.

* 3. Measuring stock with a vernier caliper to determine size.

ø 4. Reading graduations on vertical feed.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

- a. Multiplying fractions to determine exact dimensions
- b. Adding fractions to determine exact dimensions
- c. Subtracting fractions to determine exact dimensions
- d. Dividing fractions to determine exact dimensions

* 2. Applying knowledge of decimals:

- a. Adding decimals to determine exact dimensions
- b. Subtracting decimals to determine exact dimensions
- c. Multiplying decimals to determine exact dimensions
- d. Dividing decimals to determine exact dimensions

ø 3. Computing spindle speed and feed according to type of material being machined.

ø 4. Determining fractional and decimal equivalents from charts.

ø 5. Computing fractional equivalents of decimals.

ø 6. Computing decimal equivalents of fractions.

SCIENCE

ø 1. Explaining the physical properties of the machinability of various metals.

ø 2. Explaining gear drive ratios.

ø 3. Explaining heat transfer as it relates to coolants.

SKILLS

1. Laying out stock with a:
    - Δ a. Square
    - Δ b. Rule or scale
    - Δ c. Combination square
    - * d. Center head
    - * e. Hemaphrodite calipers
    - * f. Surface gauge
    - Δ g. Dividers
    - Δ h. Scriber

* 2. Cutting stock to length with:

- a. Hand saw
- b. Power hack saw
- c. Power band saw

3. Mounting holding devices on milling machine:
    - Δ a. Vises
    - Δ b. Clamps
    - ø c. Jigs and fixtures

ø 4. Cleaning machine with rag and brush to obtain accurate set up.

ø 5. Mounting stock with:

- a. Parallels
- b. Angle plate
- c. Vee block
- d. Shims
- e. Step block

ø 6. Mounting cutters, spacing and bearing collars on milling machine spindle.

ø 7. Adjusting controls to obtain proper speeds for various cutters and metals to be machined.

ø 8. Adjusting controls to obtain proper feeds for various cutters and materials.

ø 9. Aligning cutter with stock to be machined.

10. Operating horizontal milling machine to produce a flat surface.

ø 11. Applying cutting fluids to lubricate cutting action and reduce cutting temperature.

Δ 12. Removing stock from holding devices.

Δ 13. Removing burrs from finished work with:

- a. File
- b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tools for the task.

* 2. Selecting appropriate hacksaw blades for the task.

3. Selecting proper method for holding stock to be machined:

- ϕ a. Jigs and fixtures
- Δ b. Vise
- ϕ c. Angle plates
- Δ d. Clamps

ϕ 4. Selecting proper cutter for specific operation:

- a. Slab
- b. Helical tooth
- c. Form relieved
- d. Inserted tooth, stagger tooth, side

ϕ 5. Selecting (from charts) proper speeds and feeds for various cutters and materials.

ϕ 6. Selecting proper feeds for various cutters and materials.

ϕ 7. Selecting direction of cut.

ϕ 8. Removing and disposing of chips to keep work area clear and free from danger.

9. Practicing proper safety precautions when operating a horizontal milling machine:

- * a. Wearing goggles or face shield
- * b. Wearing appropriate apparel
- ϕ c. Removing all tools before starting machine
- ϕ d. Making adjustments after machine has stopped
- * e. Using only cutting tools which have been adequately sharpened
- ϕ f. Maintaining all safety guards in place

ϕ 10. Selecting proper cutting fluids for various metals.

Δ 11. Selecting proper type of file.

Δ 12. Selecting abrasive cloth for removing burrs.

WELDING

TASK 1: ARC WELDING FERROUS METALS WITH A. C. WELDER TO PRODUCE A HORIZONTAL BUTT JOINT

COMMUNICATIONS

1. Reading blueprint to determine:
   - Δ a. Size and characteristics of the workpiece
   - Δ b. Type of weld required
   - Δ c. Finish and accuracy required
   - * d. Number of items to be welded
   - Δ e. Kind of material
2. Reading equipment manuel to determine equipment set-up.

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

2. Checking fit up with a rule and square to obtain an accurate assembly.

3. Checking work with fillet gauges.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

- a. Multiplying fractions to determine exact dimensions
- b. Adding fractions to determine exact dimensions
- c. Subtracting fractions to determine exact dimensions
- d. Dividing fractions to determine exact dimensions

SCIENCE

ø 1. Explaining the physical properties of the fusibility of various metals.

ø 2. Explaining the electron theory of current flow in welding.

SKILLS

1. Laying out stock with a:
   - Δ a. square
   - Δ b. Rule or scale
   - Δ c. Combination square
   - * d. Center head
   - * e. Hemaphrodite calipers
   - * f. Surface gauge
   - Δ g. Dividers
   - * h. Trammel points
   - Δ i. Scriber
   - Δ j. Center punch

2. Cutting metal to dimensions with:
    - * a. Hand hack saw
    - * b. Power hack saw
    - * c. Power band saw
    - ∅ d. Gas cutting torch

* 3. Grinding stock to specific dimensions.

∅ 4. Grinding a bevel on heavy plate for adequate penetration.

∅ 5. Connecting electrical components on welder according to manuel specifications.

Δ 6. Clamping work to obtain fit up.

∅ 7. Grounding work to obtain adequate conductance.

* 8. Cleaning metal parts to be welded to obtain weld with necessary strength.

∅ 9. Tacking fit up assembly to minimize warpage and buckling.

∅ 10. Preheating weld area to bring metal to proper welding temperature.

∅ 11. Striking an arc to join metals together.

∅ 12. Running a bead on weld joint according to specifications.

∅ 13. Stopping and re-starting a bead for specific weld dimensions.

∅ 14. Cleaning weld with chipping hammer and wire brush for additional welding or finished weld.

Δ 15. Removing burrs from finished work with:
    - a. File
    - b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tools for the task.

* 2. Selecting appropriate hacksaw blades for the task.

∅ 3. Selecting appropriate grinder for the task.

∅ 4. Selecting correct type of electrode for size and type of metal to be welded.

∅ 5. Selecting proper heat for type and thickness of metal being welded.

ϕ 6. Positioning work to be welded in most advantageous position for gravitational effects on appearance of bead.

ϕ 7. Applying different electrode angles in relation to type and thicknesses of metal being welded.

ϕ 8. Identifying flux for removal with chipping hammer.

Δ 9. Selecting proper type of file.

Δ 10. Selecting abrasive cloth for removing burrs.

11. Practicing proper safety precautions when using electric welding equipment:

    * a. Wearing goggles or face shield
    * b. Wearing appropriate apparel
    ϕ c. Maintaining equipment regularly
    * d. Shielding welding area

NOTE: THE AREAS OF HUMAN REQUIREMENT FOR TASKS 2 THROUGH 16 ARE THE SAME AS THOSE FOR TASK ONE.

TASK 2: ARC WELDING FERROUS METALS WITH A. C. WELDER TO PRODUCE A HORIZONTAL LAP JOINT

TASK 3: ARC WELDING FERROUS METALS WITH A. C. WELDER TO PRODUCE A HORIZONTAL INSIDE CORNER JOINT

TASK 4: ARC WELDING FERROUS METALS WITH A. C. WELDER TO PRODUCE A HORIZONTAL OUTSIDE CORNER JOINT

TASK 5: ARC WELDING FERROUS METALS WITH A. C. WELDER TO PRODUCE A HORIZONTAL TEE JOINT

TASK 6: ARC WELDING FERROUS METALS WITH A. C. WELDER TO PRODUCE A VERTICAL LAP JOINT

TASK 7: ARC WELDING PIPE STOCK WITH A. C. WELDER TO PRODUCE BUTT JOINTS WHILE FIXED

TASK 8: ARC WELDING PIPE STOCK WITH A. C. WELDER TO PRODUCE BUTT JOINTS WHILE ROLLING

TASK 9: ARC WELDING FERROUS METALS WITH D. C. WELDER TO PRODUCE A HORIZONTAL BUTT JOINT

TASK 10: ARC WELDING FERROUS METALS WITH D. C. WELDER TO PRODUCE A HORIZONTAL LAP JOINT

TASK 11: ARC WELDING FERROUS METALS WITH D. C. WELDER TO PRODUCE A HORIZONTAL OUTSIDE CORNER JOINT

TASK 12: ARC WELDING FERROUS METALS WITH D. C. WELDER TO PRODUCE A HORIZONTAL INSIDE CORNER JOINT

TASK 13: ARC WELDING FERROUS METALS WITH D. C. WELDER TO PRODUCE A HORIZONTAL TEE JOINT

TASK 14: ARC WELDING FERROUS METALS WITH D. C. WELDER TO PRODUCE A VERTICAL LAP JOINT

TASK 15: ARC WELDING PIPE STOCK WITH D. C. WELDER TO PRODUCE BUTT JOINTS WHILE FIXED

TASK 16: ARC WELDING PIPE STOCK WITH D. C. WELDER TO PRODUCE BUTT JOINTS WHILE ROLLING

TASK 17: PAD WELDING LOW AREAS ON METAL STOCK TO RENEW STOCK TO ORIGINAL HEIGHT

COMMUNICATIONS

1. Reading equipment manuel to determine equipment set up.

SCIENCE

ø 1. Explaining the physical properties of the fusibility of various metals.

ø 2. Explaining the electron theory of current flow in welding.

SKILLS

ø 1. Connecting electrical components on welder according to manuel specifications.

Δ 2. Clamping work to obtain fit up.

ø 3. Grounding work to obtain adequate conductance.

* 4. Cleaning metal parts to be welded to obtain weld with necessary strength.

ϕ 5. Preheating weld area to bring metal to proper welding temperature.

ϕ 6. Striking an arc to join metals together.

ϕ 7. Running a bead on weld joint according to specifications.

ϕ 8. Stopping and re-statring a bead for specific weld dimensions.

ϕ 9. Cleaning weld with chipping hammer and wire brush for additional welding or finished weld.

Δ 10. Removing burrs from finished work with:

a. File
b. Abrasive cloth

INFORMATION

ϕ 1. Selecting correct type of electrode for size and type of metal to be welded.

ϕ 2. Selecting proper heat for type and thickness of metal being welded.

ϕ 3. Positioning work to be welded in most advantageous position for gravitational effects on appearance of bead.

ϕ 4. Identifying flux for removal with chipping hammer.

5. Practicing proper safety precautions when using electric welding equipment:

    * a. Wearing goggles or face shield
    * b. Wearing appropriate apparel
    ϕ c. Maintaining equipment regularly
    * d. Shielding welding area

TASK 18: GAS WELDING FERROUS METALS STOCK TO PRODUCE HORIZONTAL A BUTT JOINT

COMMUNICATIONS

1. Reading blueprint to determine:
   - Δ a. Size and characteristics of the workpiece
   - Δ b. Type of weld required
   - Δ c. Finish and accuracy required
   - * d. Number of items to be welded
   - Δ e. Kind of material

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

2. Checking fit up with a rule and square to obtain an accurate assembly.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:
   - a. Multiplying fractions to determine exact dimensions
   - b. Adding fractions to determine exact dimensions
   - c. Subtracting fractions to determine exact dimensions
   - d. Dividing fractions to determine exact dimensions

SCIENCE

ø 1. Explaining the physical properties of the fusibility of various metals.

SKILLS

1. Laying out stock with a:
   - Δ a. Square
   - Δ b. Rule or scale
   - Δ c. Combination square
   - * d. Center head
   - * e. Hemaphrodite calipers
   - * f. Surface gauge
   - Δ g. Dividers
   - * h. Trammel points
   - Δ i. Scriber
   - Δ j. Center punch

2. Cutting metal to dimensions with:
    - * a. Hand hack saw
    - * b. Power hack saw
    - * c. Power band saw
    - ∅ d. Gas cutting torch

* 3. Grinding stock to specific dimensions.

∅ 4. Grinding bevel on heavy plate for adequate penetration.

* 5. Cleaning metal parts to be welded to obtain weld of specific strength.

Δ 6. Clamping work to obtain fit up.

∅ 7. Attaching regulators to tanks.

∅ 8. Connecting hoses to regulators.

∅ 9. Attaching welding tip to handle.

∅ 10. Adjusting valves for desired working pressure.

∅ 11. Lighting torch with a spark lighter.

∅ 12. Adjusting flame to correct heat.

∅ 13. Running a bead with torch and filler rod.

INFORMATION

Δ 1. Selecting appropriate layout tools for the task.

* 2. Selecting appropriate hacksaw blades for the task.

∅ 3. Selecting grinder appropriate for the task.

∅ 4. Selecting proper wrenches for valve controls.

∅ 5. Selecting proper welding rod for the task.

∅ 6. Selecting appropriate welding tips for the task.

7. Practicing proper safety precautions when using gas welding equipment:
    - * a. Wearing goggles or face shield
    - * b. Wearing appropriate apparel
    - ∅ c. Inspecting equipment for leaks and valve regulation
    - ∅ d. Maintaining equipment regularly
    - * e. Shielding welding area

- ∅ f. Cracking cylinder valves
- ∅ g. Handling tanks with proper care
- ∅ h. Welding eliminating flashbacks and backfires
- ∅ i. Recognizing danger of using oil with oxygen
- ∅ j. Turning off torch in proper sequence

NOTE: THE AREAS OF HUMAN REQUIREMENT FOR TASKS 19 THROUGH 23 ARE THE SAME AS THOSE FOR TASK 18.

TASK 19: GAS WELDING FERROUS METALS STOCK TO PRODUCE A HORIZONTAL LAP JOINT

TASK 20: GAS WELDING FERROUS METALS STOCK TO PRODUCE A HORIZONTAL OUTSIDE CORNER JOINT

TASK 21: GAS WELDING FERROUS METALS STOCK TO PRODUCE A HORIZONTAL INSIDE CORNER JOINT

TASK 22: GAS WELDING FERROUS METALS STOCK TO PRODUCE A HORIZONTAL TEE JOINT

TASK 23: GAS WELDING FERROUS METALS STOCK TO PRODUCE A VERTICAL LAP JOINT

TASK 24: GAS CUTTING FERROUS CARBON STEELS

COMMUNICATIONS

1. Reading blueprint to determine:

   - Δ a. Size and characteristics of the workpiece
   - Δ b. Type of cut required
   - Δ c. Finish and accuracy required
   - * d. Number of items to be cut
   - Δ e. Kind of material

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

    a. Multiplying fractions to determine exact dimensions
    b. Adding fractions to determine exact dimensions
    c. Subtracting fractions to determine exact dimensions
    d. Dividing fractions to determine exact dimensions

SKILLS

1. Laying out stock with a:

    Δ a. Square
    Δ b. Rule or scale
    Δ c. Combination square
    * d. Center head
    * e. Hermaphrodite calipers
    * Surface gauge
    Δ g. Dividers
    * h. Trammel points
    Δ i. Scriber
    Δ j. Center punch

Δ 2. Mounting stock in:

    a. Clamps
    b. Vise

∅ 3. Lighting torch with a spark lighter.

∅ 4. Adjusting flame to correct heat.

∅ 5. Cutting metal to dimensions with a gas cutting torch.

INFORMATION

Δ 1. Selecting appropriate layout tools for the task.

* 2. Selecting appropriate hacksaw blades for the task.

∅ 3. Selecting proper wrenches for valve controls.

∅ 4. Selecting appropriate cutting tips for the task.

5. Practicing proper safety precautions when using gas cutting equipment:

    * a. Wearing goggles or face shield
    * b. Wearing appropriate apparel
    ∅ c. Inspecting equipment for leaks and valve regulation
    ∅ d. Maintaining equipment regularly
    * e. Shielding cutting area
    ∅ f. Cracking cylinder valves
    ∅ g. Handling tanks with proper care
    ∅ h. Cutting, eliminating flashbacks and backfires
    ∅ i. Recognizing danger of using oil with oxygen
    ∅ j. Turning off torch in proper sequence

TASK 25: BRAZING FERROUS METALS TO PRODUCE A HORIZONTAL BUTT JOINT

COMMUNICATIONS

1. Reading blueprint to determine:

   - Δ a. Size and characteristics of the workpiece
   - Δ b. Type of braze joint required
   - Δ c. Finish and accuracy required
   - * d. Number of items to be brazed
   - Δ e. Kind of material

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

2. Checking fit up with a rule and square to obtain an accurate assembly.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

   - a. Multiplying fractions to determine exact dimensions
   - b. Adding fractions to determine exact dimensions
   - c. Subtracting fractions to determine exact dimensions
   - d. Dividing fractions to determine exact dimensions

SCIENCE

ϕ 1. Explaining the physical properties of the fusibility of various metals.

SKILLS

1. Laying out stock with a:

   - Δ a. Square
   - Δ b. Rule or scale
   - Δ c. Combination square
   - * d. Center head
   - * e. Hemaphrodite calipers
   - * f. Surface gauge
   - Δ g. Dividers
   - * h. Trammel points
   - Δ i. Scriber
   - Δ j. Center punch

2. Cutting metal to dimensions with:

    * a. Hand hack saw
    * b. Power hack saw
    * c. Power band saw
    ϕ d. Gas cutting torch

* 3 Grinding stock to specific dimensions.

ϕ 4. Grinding bevel on heavy plate for adequate penetration.

* 5. Cleaning metal parts to be brazed to obtain braze joint of specific strength.

Δ 6. Clamping work to obtain fit up.

ϕ 7. Attaching regulators to tanks.

ϕ 8. Connecting hoses to regulators.

ϕ 9. Attaching brazing tip to handle.

ϕ 10. Adjusting valves for desired working pressure.

ϕ 11. Lighting torch with a spark lighter.

ϕ 12. Adjusting flame to correct heat.

ϕ 13. Running a bead with torch and filler rod.

INFORMATION

Δ 1. Selecting appropriate layout tools for the task.

* 2. Selecting appropriate hacksaw blades for the task.

ϕ 3. Selecting grinder appropriate for the task.

ϕ 4. Selecting proper wrenches for valve controls.

ϕ 5. Selecting proper brazing rod for the task.

ϕ 6. Selecting appropriate brazing tips for the task.

7. Practicing proper safety precautions when using gas brazing equipment:

    * a. Wearing goggles or face shielf
    * b. Wearing appropriate apparel
    ϕ c. Inspecting equipment for leaks and valve regulation
    ϕ d. Maintaining equipment regularly
    * e. Shielding brazing area

- ø f. Cracking cylinder valves
- ø g. Handling tanks with proper care
- ø h. Brazing eliminating flashbacks and backfires
- ø i. Recognizing danger of using oil with oxygen
- ø j. Turning off torch in proper sequence

NOTE: THE AREAS OF HUMAN REQUIREMENT FOR TASKS 26 THROUGH 30 ARE THE SAME AS THOSE FOR TASK 25.

TASK 26: BRAZING FERROUS METALS TO PRODUCE A HORIZONTAL LAP JOINT

TASK 27: BRAZING FERROUS METALS TO PRODUCE A HORIZONTAL OUTSIDE CORNER JOINT

TASK 28: BRAZING FERROUS METALS TO PRODUCE A HORIZONTAL INSIDE CORNER JOINT

TASK 29: BRAZING FERROUS METALS TO PRODUCE A HORIZONTAL TEE JOINT

TASK 30: BRAZING FERROUS METALS TO PRODUCE A VERTICAL LAP JOINT

TASK 31: BRAZING NON-FERROUS METALS TO PRODUCE A HORIZONTAL BUTT JOINT

COMMUNICATIONS

1. Reading blueprint to determine:
   - Δ a. Size and characteristics of the workpiece
   - Δ b. Type of braze required
   - Δ c. Finish and accuracy required
   - * d. Number of items to be brazed
   - Δ e. Kind of material

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

2. Checking fit up with a rule and square to obtain an accuarte assembly.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

a. Multiplying fractions to determine exact dimensions
b. Adding fractions to determine exact dimensions
c. Subtracting fractions to determine exact dimensions
d. Dividing fractions to determine exact dimensions

SCIENCE

ø 1. Explaining the physical properties of the fusibility of various metals.

SKILLS

1. Laying out stock with a:

Δ a. Square
Δ b. Rule or scale
Δ c. Combination square
* d. Center head
* e. Hemaphrodite calipers
* f. Surface gauge
Δ g. Dividers
* h. Trammel points
Δ i. Scriber

* 2. Cutting metal to dimensions with:

a. Hand hack saw
b. Power hack saw
c. Power band saw

* 3. Grinding stock to specific dimensions.

ø 4. Grinding bevel on heavy plate for adequate penetration.

* 5. Cleaning metal parts to be brazed to obtain braze joint of specific strength.

Δ 6. Clamping work to obtain fit up.

ø 7. Attaching regulators to tanks.

ø 8. Connecting hoses to regulators.

ø 9. Attaching brazing tip to handle.

ø 10. Adjusting valves for desired working pressure.

ø 11. Lighting torch with a spark lighter.

ø 12. Adjusting flame to correct heat.

ø 13. Running a bead with torch and filler rod.

INFORMATION

Δ 1. Selecting appropriate layout tools for the task.

* 2. Selecting appropriate hacksaw blades for the task.

ø 3. Selecting grinder appropriate for the task.

ø 4. Selecting proper wrenches for valve controls.

ø 5. Selecting proper brazing rod for the task.

ø 6. Selecting appropriate brazing tips for the task.

7. Practicing proper safety precautions when using gas brazing equipment:

   * a. Wearing goggles or face shield
   * b. Wearing appropriate apparel
   ø c. Inspecting equipment for leaks and valve regulation
   ø d. Maintaining equipment regularly
   * e. Shielding brazing area
   ø f. Cracking cylinder valves
   ø g. Handling tanks with proper care
   ø h. Brazing, eliminating flashbacks and backfires
   ø i. Recognizing danger of using oil with oxygen
   ø j. Turning off torch in proper sequence

NOTE: THE AREAS OF HUMAN REQUIREMENT FOR TASKS 32 THROUGH 36 ARE THE SAME AS THOSE FOR TASK 31.

TASK 32: BRAZING NON-FERROUS METALS TO PRODUCE A HORIZONTAL LAP JOINT

TASK 33: BRAZING NON-FERROUS METALS TO PRODUCE A HORIZONTAL OUTSIDE CORNER JOINT

TASK 34: BRAZING NON-FERROUS METALS TO PRODUCE A HORIZONTAL INSIDE CORNER JOINT

TASK 35: BRAZING NON-FERROUS METALS TO PRODUCE A HORIZONTAL TEE JOINT

TASK 36: BRAZING NON-FERROUS METALS TO PRODUCE A VERTICAL LAP JOINT

TASK 37: INERT GAS WELDING FERROUS METALS TO PRODUCE A HORIZONTAL BUTT JOINT

COMMUNICATIONS

1. Reading blueprint to determine:
   - Δ a. Size and characteristics of the workpiece
   - Δ b. Type of weld required
   - Δ c. Finish and accuracy
   - * d. Number of items to be welded
   - Δ e. Kind of material
2. Reading equipment manuel to determine equipment set up.

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

2. Checking fit up with a rule and square for accuracy.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:
   - a. Multiplying fractions to determine exact dimensions
   - b. Adding fractions to determine exact dimensions
   - c. Subtracting fractions to determine exact dimensions
   - d. Dividing fractions to determine exact dimensions

SCIENCE

∅ 1. Explaining the physical properties of the fusibility of various metals.

SKILLS

1. Laying out stock with a:
   - Δ a. Square
   - Δ b. Rule or scale
   - Δ c. Combination square
   - * d. Center head
   - * e. Hermphrodite calipers
   - * f. Surface gauge
   - Δ g. Dividers
   - * h. Trammel points

- Δ i. Scriber
- Δ j. Center punch

2. Cutting metal to dimensions with:

   - * a. Hand hack saw
   - * b. Power hack saw
   - * c. Power band saw
   - ϕ d. Gas cutting torch

ϕ 3. Installing consumable filler wire in mig welding equipment.

ϕ 4. Checking electrical connections for tightness.

ϕ 5. Setting up inert gas welding equipment according to welder manuel.

ϕ 6. Checking inert gas fittings for tightness.

Δ 7. Grinding stock to specific dimension and weld angles.

Δ 8. Clamping work to obtain fit up.

* 9. Cleaning metal parts to be welded to obtain maximum strength from weld.

ϕ 10. Preparing tungsten electrode for type current to be used.

ϕ 11. Striking an arc to begin welding process.

ϕ 12. Tacking fit up to relieve stresses.

ϕ 13. Running a bead on weld joint according to specifications.

Δ 14. Removing burrs with:

   a. File
   b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tools for the task.

* 2. Selecting appropriate hacksaw blades for the task.

ϕ 3. Selecting correct type of electrode for the task.

ϕ 4. Selecting type current to be used according to metal being welded.

ϕ 5. Recognizing various sizes and types of welding tips.

ϕ 6. Positioning work to be welded in most advantageous position for gravitational effects on appearance of bead.

ϕ 7. Applying different angles in relation to type and thickness of metal.

ϕ 8. Standing in proper relation to work to be welded.

Δ 9. Selecting appropriate file for task.

Δ 10. Selecting appropriate abrasive cloth for task.

11. Practicing proper safety precautions when using inert gas welding equipment.

    * a. Wearing goggles or face shield
    * b. Wearing appropriate apparel
    ϕ c. Maintaining equipment regularly
    * d. Shield welding area

NOTE: THE AREAS OF HUMAN REQUIREMENT FOR TASKS 38 THROUGH 44 ARE THE SAME AS THOSE FOR TASK 37.

TASK 38: INERT GAS WELDING FERROUS METALS TO PRODUCE A HORIZONTAL LAP JOINT

TASK 39: INERT GAS WELDING FERROUS METALS TO PRODUCE A HORIZONTAL OUTSIDE CORNER JOINT

TASK 40: INERT GAS WELDING FERROUS METALS TO PRODUCE A HORIZONTAL INSIDE CORNER JOINT

TASK 41: INERT GAS WELDING FERROUS METALS TO PRODUCE A HORIZONTAL TEE JOINT

TASK 42: INERT GAS WELDING FERROUS METALS TO PRODUCE A VERTICAL LAP JOINT

TASK 43: INERT GAS WELDING FERROUS PIPE STOCK TO PRODUCE BUTT JOINTS WHILE ROLLING

TASK 44: INERT GAS WELDING FERROUS PIPE STOCK TO PRODUCE BUTT JOINTS WHILE FIXED

TASK 45: INERT GAS WELDING NON-FERROUS METALS TO PRODUCE A HORIZONTAL BUTT JOINT

COMMUNICATIONS

1. Reading blueprint to determine:
    - Δ a. Size and characteristics of the workpiece
    - Δ b. Type of weld required
    - Δ c. Finish and accuracy
    - * d. Number of items to be welded
    - Δ e. Kind of material

2. Reading equipment manuel to determine equipment set up.

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

2. Checking fit up with a rule and square for accuracy.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:
    - a. Multiplying fractions to determine exact dimensions
    - b. Adding fractions to determine exact dimensions
    - c. Subtracting fractions to determine exact dimensions
    - d. Dividing fractions to determine exact dimensions

SCIENCE

∅ 1. Explaining the physical properties of the fusibility of various metals.

SKILLS

1. Laying out stock with a:
    - Δ a. Square
    - Δ b. Rule or scale
    - Δ c. Combination square
    - * d. Center head
    - * e. Hermphrodite calipers
    - * f. Surface gauge

    * g. Dividers
    * h. Trammel points
    Δ i. Scriber

* 2. Cutting metal to dimensions with:

    a. Hand hack saw
    b. Power hack saw
    c. Power band saw

ϕ 3. Installing consumable filler wire in mig welding equipment.

ϕ 4. Checking electrical connections for tightness.

ϕ 5. Setting up inert gas welding equipment according to welder manuel.

ϕ 6. Checking inert gas fittings for tightness.

ϕ 7. Belt sanding stock to specific dimensions and weld angles.

Δ 8. Clamping work to obtain fit up.

* 9. Cleaning metal parts to be welded to obtain maximum strengt from weld.

ϕ 10. Preparing tungsten electrode for type current to be used.

ϕ 11. Striking an arc to begin welding process.

ϕ 12. Tacking fit up to relieve stresses.

ϕ 13. Running a bead on weld joint according to specifications.

Δ 14. Removing burrs with:

    a. File
    b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tools for the task.

* 2. Selecting appropriate hacksaw blades for the task.

ϕ 3. Selecting correct type of electrode for the task.

ϕ 4. Selecting type current to be used according to metal being welded.

ϕ 5. Recognizing various sizes and types of welding tips.

ϕ 6. Positioning work to be welded in most advantageous position for gravitational effects on appearance of bead.

ϕ 7. Applying different angles in relation to type and thickness of metal.

ϕ 8. Standing in proper relation to work to be welded.

Δ 9. Selecting appropriate file for task.

Δ 10. Selecting appropriate abrasive cloth for task.

11. Practicing proper safety precautions when using inert gas welding equipment.

    * a. Wearing goggles or face shield
    * b. Wearing appropriate apparel
    † c. Maintaining equipment regularly
    * d. Shield welding area

NOTE: THE AREAS OF HUMAN REQUIREMENT FOR TASKS 46 THROUGH 52 ARE THE SAME AS THOSE FOR TASK 45.

TASK 46: INERT GAS WELDING NON-FERROUS METALS TO PRODUCE A HORIZONTAL LAP JOINT

TASK 47: INERT GAS WELDING NON-FERROUS METALS TO PRODUCE A HORIZONTAL INSIDE CORNER JOINT

TASK 48: INERT GAS WELDING NON-FERROUS METALS TO PRODUCE A HORIZONTAL OUTSIDE CORNER JOINT

TASK 49: INERT GAS WELDING NON-FERROUS METALS TO PRODUCE A HORIZONTAL TEE JOINT

TASK 50: INERT GAS WELDING NON-FERROUS METALS TO PRODUCE A VERTICAL LAP JOINT

TASK 51: INERT GAS WELDING NON-FERROUS PIPE STOCK TO PRODUCE BUTT JOINTS WHILE ROLLING

TASK 52: INERT GAS WELDING NON-FERROUS PIPE STOCK TO PRODUCE BUTT JOINTS WHILE FIXED

SHEET METAL WORK

TASK 1: TRACING TEMPLATES ON SHEET METAL FOR CUTTING, BENDING AND JOINING SHEET METAL ITEMS

MEASUREMENT

Δ 1. Checking overall length of sheet metal with tape.

ϕ 2. Checking gauge of sheet metal with sheet metal gauge or micrometer.

3. Locating points on sheet metal for the scribing of lines.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

    a. Multiplying fractions to determine exact dimensions
    b. Adding fractions to determine exact dimensions
    c. Subtracting fractions to determine exact dimensions
    d. Dividing fractions to determine exact dimensions

* 2. Applying knowledge of decimals:

    a. Adding decimals to determine exact dimensions
    b. Subtracting decimals to determine exact dimensions
    c. Multiplying decimals to determine exact dimensions
    d. Dividing decimals to determine exact dimensions

SKILLS

Δ 1. Scribing lines around templates with scriber.

TASK 2: CUTTING SHEET METAL WITH HAND TOOLS TO PRODUCE A STRAIGHT CUT WITHIN 1/32 OF AN INCH

COMMUNICATIONS

Δ 1. Reading blueprint to determine:

    a. Size and characteristics of the workpiece
    b. Type of operation
    c. Finish and accuracy required
    d. Kind of material

MEASUREMENT

Δ 1. Checking overall length of sheet metal with rule or tape.

* 2. Checking gauge of sheet metal with sheet metal gauge or micrometer.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

  a. Multiplying fractions to determine exact dimensions
  b. Adding fractions to determine exact dimensions
  c. Subtracting fractions to determine exact dimensions
  d. Dividing fractions to determine exact dimensions

* 2. Applying knowledge of decimals:

  a. Adding decimals to determine exact dimensions
  b. Subtracting decimals to determine exact dimensions
  c. Multiplying decimals to determine exact dimensions
  d. Dividing decimals to determine exact dimensions

SKILLS

1. Laying out stock with a:

  Δ a. Square
  Δ b. Rule or scale
  Δ c. Dividers
  * d. Trammel points
  Δ e. Scriber
  Δ f. Center punch

ø 2. Adjusting pivot screw on hand shears for proper clearance for cut.

* 3. Aligning sheet metal with shear blade for an accurate cut.

* 4. Cutting sheet metal with aviation snips (right-hand and left-hand) to produce a straight cut within 1/32 of an inch.

* 5. Cutting sheet metal (24 gauge or thinner) with combination snips to produce straight cut within 1/32 of an inch.

* 6. Cutting sheet metal with straight snips to produce a straight cut within 1/32 of an inch.

* 7. Cutting sheet metal with compound shears to produce a straight cut within 1/32 of an inch.

* 8. Cutting sheet metal (24 gauge or thicker) with bulldog snips to produce a straight cut within 1/32 of an inch.

* 9. Cutting sheet metal pipe with double cutting shears to produce a straight cut within 1/32 of an inch.

Δ 10. Removing burrs from sheet metal with:

    a. File
    b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tool for task.

* 2. Selecting most appropriate hand cutting tool for the task.

Δ 3. Selecting appropriate abrasive cloth for task.

Δ 4. Selecting appropriate file for task.

ϕ 5. Wearing gloves when handling sharp sheet metal.

TASK 3: CUTTING SHEET METAL WITH MACHINERY TO PRODUCE A STRAIGHT CUT WITHIN 1/32 OF AN INCH

COMMUNICATIONS

Δ 1. Reading blueprint to determine:

    a. Size and characteristics of the workpiece
    b. Type of operation
    c. Finish and accuracy required
    d. Kind of material

MEASUREMENT

Δ 1. Checking overall length of sheet metal with rule or tape.

ϕ 2. Reading graduations on sheet metal machinery to determine specific dimensions.

* 3. Checking gauge of sheet metal with sheet metal gauge or micrometer.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

   a. Multiplying fractions to determine exact dimensions
   b. Adding fractions to determine exact dimensions
   c. Subtracting fractions to determine exact dimensions
   d. Dividing fractions to determine exact dimensions

* 2. Applying knowledge of decimals:

   a. Adding decimals to determine exact dimensions
   b. Subtracting decimals to determine exact dimensions
   c. Multiplying decimals to determine exact dimensions
   d. Dividing decimals to determine exact dimensions

SKILLS

1. Laying out stock with a:

   Δ a. Square
   Δ b. Rule or scale
   Δ c. Dividers
   * d. Trammel points
   Δ e. Scriber
   Δ f. Center punch

* 2. Aligning sheet metal with shear blade for an accurate cut.

* 3. Cutting sheet metal with treddle operated squaring shears to produce a straight cut within 1/32 of an inch.

* 4. Cutting sheet metal with power operated squaring shears to produce a straight cut within 1/32 of an inch.

* 5. Cutting sheet metal with saber saw to produce a straight cut within 1/32 of an inch.

Δ 6. Removing burrs from sheet metal with a:

   a. File
   b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tools for task.

ø 2. Selecting the most appropriate machinery for task.

Δ 3. Selecting appropriate abrasive cloth for task.

Δ 4. Selecting appropriate file for task.

ϕ 5. Wearing gloves when handling sharp sheet metal.

TASK 4: CUTTING SHEET METAL WITH HAND TOOLS TO PRODUCE A CIRCULAR CUT WITHIN 1/32 OF AN INCH

COMMUNICATIONS

Δ 1. Reading blueprint to determine:

  a. Size and characteristics of the workpiece
  b. Type of operation
  c. Finish and accuracy required
  d. Kind of material

MEASUREMENT

Δ 1. Checking overall length of sheet metal with rule or tape.

* 2. Checking gauge of sheet metal with sheet metal gauge or micrometer.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

  a. Multiplying fractions to determine exact dimensions
  b. Adding fractions to determine exact dimensions
  c. Subtracting fractions to determine exact dimensions
  d. Dividing fractions to determine exact dimensions

* 2. Applying knowledge of decimals:

  a. Adding decimals to determine exact dimensions
  b. Subtracting decimals to determine exact dimensions
  c. Multiplying decimals to determine exact dimensions
  d. Dividing decimals to determine exact dimensions

SKILLS

1. Laying out stock with a:

  Δ a. Square
  Δ b. Rule or scale
  Δ c. Dividers
  * d. Trammel points

Δ e. Scriber
Δ f. Center punch

ϕ 2. Adjusting pivot screw on hand shears for proper clearance for cut.

* 3. Aligning sheet metal with shear blade for an accurate cut.

* 4. Cutting sheet metal with aviation snips (right or left hand) to produce a circular cut within 1/32 of an inch.

* 5. Cutting sheet metal with combination snips to produce a circular cut within 1/32 of an inch.

* 6. Cutting sheet metal with straight snips to produce a circular cut within 1/32 of an inch.

* 7. Cutting sheet metal with circle snips to produce a circular cut within 1/32 of an inch.

* 8. Cutting sheet metal with Hawk's Bill snips to produce a circular cut within 1/32 of an inch.

Δ 9. Removing burrs from sheet metal with:

a. File
b. Abrasive cloth

INFORMATIONS

Δ 1. Selecting appropriate layout tools for task.

* 2. Selecting most appropriate hand cutting tool for the task.

Δ 3. Selecting appropriate abrasive cloth for task.

Δ 4. Selecting appropriate file for task.

ϕ 5. Wearing gloves when handling sharp sheet metal.

TASK 5: CUTTING SHEET METAL WITH MACHINERY TO PRODUCE A CIRCULAR CUT WITHIN 1/32 OF AN INCH

COMMUNICATIONS

Δ 1. Reading blueprint to determine:

a. Size and characteristics of the workpiece
b. Type of operation

  - Δ c. Finish and accuracy required
  - Δ d. Kind of material

MEASUREMENT

Δ 1. Checking overall length of sheet metal with rule or scale.

* 2. Checking gauge of sheet metal with sheet metal gauge or micrometer.

3. Checking measurement of required circle on graduations on bed scale.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

  a. Multiplying fractions to determine exact dimensions
  b. Adding fractions to determine exact dimensions
  c. Subtracting fractions to determine exact dimensions
  d. Dividing fractions to determine exact dimensions

* 2. Applying knowledge of decimals:

  a. Adding decimals to determine exact dimensions
  b. Subtracting decimals to determine exact dimensions
  c. Multiplying decimals to determine exact dimensions
  d. Dividing decimals to determine exact dimensions

SKILLS

1. Laying out stock with a:

  Δ a. Square
  Δ b. Rule or scale
  Δ c. Dividers
  * d. Trammel points
  Δ e. Scriber
  Δ f. Center punch

* 2. Aligning sheet metal with shear blade for an accurate cut.

3. Centering blank in ring and circle shear.

ϕ 4. Setting lock nut on adjustment handle to produce a clean cut.

ϕ 5. Adjusting upper cutter adjustment handle or ring and circle cutter for specific gage metal being cut.

* 6. Cutting sheet metal with bench level shear to produce a circular cut within 1/32 of an inch.

* 7. Cutting sheet metal with ring and circle shear to produce a curcular cut within 1/32 of an inch.

Δ 8. Removing burrs from sheet metal with:

a. File
b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tools for task.

* 2. Selecting most appropriate hand cutting tool for the task.

Δ 3. Selecting appropriate abrasive cloth for task.

Δ 4. Selecting appropriate file for task.

ϕ 5. Wearing gloves when handling sharp sheet metal.

TASK 6: CUTTING SHEET METAL WITH HAND TOOLS TO PRODUCE AN IRREGULAR CUT WITHIN 1/32 OF AN INCH

COMMUNICATIONS

Δ 1. Reading blueprint to determine:

a. Size and characteristics of the workpiece
b. Type of operation
c. Finish and accuracy required
d. Kind of material

MEASUREMENT

Δ 1. Checking overall length of sheet metal with rule or tape.

* 2. Checking gauge of sheet metal with sheet metal gauge or micrometer.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

a. Multiplying fractions to determine exact dimensions

b. Adding fractions to determine exact dimensions
c. Subtracting fractions to determine exact dimensions
d. Dividing fractions to determine exact dimensions

* 2. Applying knowledge of decimals:

a. Adding decimals to determine exact dimensions
b. Subtracting decimals to determine exact dimensions
c. Multiplying decimals to determine exact dimensions
d. Dividing decimals to determine e act dimensions

SKILLS

1. Laying out stock with a:

Δ a. Square
Δ b. Rule or scale
Δ c. Dividers
* d. Trammel points
Δ e. Scriber
Δ f. Center punch

ϕ 2. Adjusting pivot screw on hand shears for proper clearance for cut.

* 3. Aligning sheet metal with shear blade for an accurate cut.

* 4. Cutting sheet metal with aviation snips to produce an irregular cut within 1/32 of an inch.

* 5. Cutting sheet metal with combination snips to produce an irregular cut within 1/32 of an inch.

* 6. Cutting sheet metal with bench lever shears to produce an irregular cut within 1/32 of an inch.

Δ 7. Removing burrs from sheet metal with a:

a. File
b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tools for task.

* 2. Selecting most appropriate hand cutting tool for the task.

Δ 3. Selecting appropriate abrasive cloth for task.

Δ 4. Selecting appropriate file for task.

ϕ 5. Wearing gloves when handling sharp sheet metal.

TASK 7: CUTTING SHEET METAL WITH MACHINERY TO PRODUCE AN IRREGULAR CUT WITHIN 1/32 OF AN INCH

COMMUNICATIONS

Δ 1. Reading blueprint to determine:

- a. Size and characteristics of the workpiece
- b. Type of operation
- c. Finish and accuracy required
- d. Kind of material

MEASUREMENT

Δ 1. Checking overall length of sheet metal with rule or tape.

* 2. Checking gauge of sheet metal with sheet metal gauge or micrometer.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

- a. Multiplying fractions to determine exact dimensions
- b. Adding fractions to determine exact dimensions
- c. Subtracting fractions to determine exact dimensions
- d. Dividing fractions to determine exact dimensions

* 2. Applying knowledge of decimals:

- a. Adding decimals to determine exact dimensions
- b. Subtracting decimals to determine exact dimensions
- c. Multiplying decimals to determine exact dimensions
- d. Dividing decimals to determine exact dimensions

SKILLS

1. Laying out stock with a:

- Δ a. Square
- Δ b. Rule or scale
- Δ c. Dividers
- * d. Trammel points
- Δ e. Scriber
- Δ f. Center punch

* 2. Aligning sheet metal with shear blade for an accurate cut.

ϕ 3. Adjusting upper cutter adjustment handle on ring and circle cutter for specific gage metal being cut.

ϕ 4. Cutting sheet metal with ring and circle shears to produce an irregular cut within 1/32 of an inch.

ϕ 5. Operating a ring and circle cutter to produce an irregular cut.within 1/32 of an inch.

Δ 6. Removing burrs from sheet metal with:

   a. File
   b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tools for task.

* 2. Selecting most appropriate hand cutting tool for the task.

Δ 3. Selecting appropriate abrasive cloth for task.

Δ 4. Selecting appropriate file for task.

ϕ 5. Wearing gloves when handling sharp sheet metal.

TASK 8: CUTTING SHEET METAL WITH HAND TOOLS TO PRODUCE A NOTCHED CUT WITHIN 1/32 OF AN INCH

COMMUNICATIONS

Δ 1. Reading blueprint to determine:

   a. Size and characteristics of the workpiece
   b. Type of operation
   c. Finish and accuracy required
   d. Kind of material

MEASUREMENT

Δ 1. Checking overall length of sheet metal with rule or tape.

* 2. Checking gauge of sheet metal with sheet metal gauge or micrometer.

3

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

  a. Multiplying fractions to determine exact dimensions
  b. Adding fractions to determine exact dimensions
  c. Subtracting fractions to determine exact dimensions
  d. Dividing fractions to determine exact dimensions

* 2. Applying knowledge of decimals:

  a. Adding decimals to determine exact dimensions
  b. Subtracting decimals to determine exact dimensions
  c. Multiplying decimals to determine exact dimensions
  d. Dividing decimals to determine exact dimensions

SKILLS

1. Laying out stock with a:

  Δ a. Square
  Δ b. Rule or scale
  Δ c. Dividers
  * d. Trammel points
  Δ e. Scriber
  Δ f. Center punch

ϕ 2. Adjusting pivot screw on hand shears for proper clearance for cut.

* 3. Aligning sheet metal with shear blade for an accurate cut.

* 4. Cutting sheet metal with airplane snips (right and left hand) to produce a notched cut within 1/32 of an inch.

* 5. Cutting sheet metal with hand notcher to produce a notched cut within 1/32 of an inch.

* 6. Cutting sheet metal with bulldog snips to produce a notched cut within 1/32 of an inch.

* 7. Cutting sheet metal with combination snips to produce a notched cut within 1/32 of an inch.

* 8. Cutting sheet metal with bench level shear to produce a notched cut within 1/32 of an inch.

Δ 9. Removing burrs from sheet metal with:

  a. File
  b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tools for task.

* 2. Selecting most appropriate hand cutting tool for the task.

Δ 3. Selecting appropriate abrasive cloth for task.

Δ 4. Selecting appropriate file for task.

ϕ 5. Wearing gloves when handling sharp sheet metal.

TASK 9: CUTTING SHEET METAL WITH MACHINERY TO PRODUCE A NOTCHED CUT WITHIN 1/32 OF AN INCH

COMMUNICATIONS

Δ 1. Reading blueprint to determine:

  a. Size and characteristics of the workpiece
  b. Type of operation
  c. Finish and accuracy required
  d. Kind of material

MEASUREMENT

Δ 1. Checking overall length of sheet metal with rule or tape.

* 2. Checking gauge of sheet metal with sheet metal gauge or micrometer.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

  a. Multiplying fractions to determine exact dimensions
  b. Adding fractions to determine exact dimensions
  c. Subtracting fractions to determine exact dimensions
  d. Dividing fractions to determine exact dimensions

* 2. Applying knowledge of decimals:

  a. Adding decimals to determine exact dimensions
  b. Subtracting decimals to determine exact dimensions
  c. Multiplying decimals to determine exact dimensions
  d. Dividing decimals to determine exact dimensions

SKILLS

1. Laying out stock with a:

   Δ a. Square
   Δ b. Rule or scale
   Δ c. Dividers
   * d. Trammel points
   Δ e. Scriber
   Δ f. Center punch

2. Aligning sheet metal with shear blade for an accurate cut.

ϕ 3. Adjusting blades of notches for desired notched style.

* 4. Cutting sheet metal with portable power shears to produce a notched cut within 1/32 of an inch.

* 5. Cutting sheet metal with combination notcher, coper, and shear to produce a notched cut within 1/32 of an inch.

* 6. Cutting sheet metal with saber saw to produce an interior cut within 1/32 of an inch.

7. Cutting sheet metal with a nibbler to produce an interior cut within 1/32 of an inch.

Δ 8. Removing burrs from sheet metal with a:

   a. File
   b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tools for task.

* 2. Selecting most appropriate hand cutting tool for the task.

Δ 3. Selecting appropriate abrasive cloth for task.

Δ 4. Selecting appropriate file for task.

ϕ 5. Wearing gloves when handling sharp sheet metal.

TASK 10: CUTTING SHEET METAL TO PRODUCE AN INTERIOR CUT WITHIN 1/32 OF AN INCH

Δ 1. Reading blueprint to determine:

a. Size and characteristics of the workpiece
b. Type of operation
c. Finish and accuracy required
d. Kind of material

MEASUREMENT

Δ 1. Checking overall length of sheet metal with rule or tape.

* 2. Checking gauge of sheet metal with sheet metal gauge or micrometer.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

a. Multiplying fractions to determine exact dimensions
b. Adding fractions to determine exact dimensions
c. Subtracting fractions to determine exact dimensions
d. Dividing fractions to determine exact dimensions

* 2. Applying knowledge of decimals:

a. Adding decimals to determine exact dimensions
b. Subtracting decimals to determine exact dimensions
c. Multiplying decimals to determine exact dimensions
d. Dividing decimals to determine exact dimensions

SKILLS

1. Laying out stock with a:

Δ a. Square
Δ b. Rule or scale
Δ c. Dividers
* d. Trammel points
Δ e. Scriber
Δ f. Center punch

* 2. Adjusting pivot screw on hand shears for proper clearance for cut.

* 3. Aligning sheet metal with shear blade for an accurate cut.

* 4. Cutting sheet metal with aviation snips (straight right hand, left hand) to produce an interior cut within 1/32 of an inch.

* 5. Cutting sheet metal with a portable power shear to produce an interior cut within 1/32 of an inch.

* 6. Cutting sheet metal with hawk bill snips to produce an interior cut within 1/32 of an inch.

* 7. Cutting sheet metal with saber saw to produce an interior cut within 1/32 of an inch.

Δ 8. Removing burrs from sheet metal with a:

  a. File
  b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tools for task.

* 2. Selecting most appropriate hand cutting tool for the task.

Δ 3. Selecting appropriate abrasive cloth for task.

Δ 4. Selecting appropriate file for task.

ϕ 5. Wearing gloves when handling sharp sheet metal.

TASK 11: FORMING SHEET METAL CYLINDERICAL SHAPES ON SLIP ROLL FORMING MACHINE

SKILLS

1. Adjusting bottom roll for receiving specific gage sheet metal.
2. Adjusting back roller for forming cylinder.
3. Operating slip roll forming machine to produce a cylinder.
4. Readjusting back roller for small cylinder shape.
5. Removing cylinderical shape from slip roll forming machine.

TASK 12: FORMING SHEET METAL CRIMPING ON A CRIMPING MACHINE

MEASUREMENT

Δ 1. Measuring with rule to set gage on crimping machine.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

   a. Adding fractions to determine exact dimensions
   b. Subtracting fractions to determine exact dimensions

SKILLS

1. Installing crimping rolls on crimping machine.

2. Adjusting gage on crimping machine to produce a specific length crimp.

3. Operating crimping machine to produce a crimped edge.

4. Adjusting crankscrew for specific depth of crimp.

5. Adjusting wing nuts for light or heavy bead when using beading and crimping rolls.

ϕ 6. Holding work in a horizontal position against gage.

INFORMATION

1. Operating crimping machine without running over the seam.

TASK 13: FORMING SHEET METAL BEADING ON A BEADING MACHINE

MEASUREMENT

Δ 1. Measuring with rule to set gage on beading machine.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

   a. Adding fractions to determine exact dimensions
   b. Subtracting fractions to determine exact dimensions

SKILLS

1. Installing beading rolls on beading machine.

2. Checking alignment of the rolls for equal side clearance.

3. Adjusting gage on beading machine to set distance for bead.

ϕ 4. Holding work against gage for uniform bead.

5. Operating beading machine to produce a bead.

INFORMATION

1. Selecting proper beading rolls for the task called for in blueprint.

2. Operating beading machine without running over seam

TASK 14: FORMING A SINGLE HEM ON BAR FOLDER OR BRAKE FOR STRENGTH

MEASUREMENT

ϕ 1. Reading scale adjustment on bar folder for depth of bend.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

    a. Adding fractions to determine exact dimensions
    b. Subtracting fractions to determine exact dimensions

SKILLS

ϕ 1. Adjusting depth gage on bar folder for specific size hem.

2. Operating bar folder to produce a hem.

ϕ 3. Aligning layout line with bending leaf.

4. Operating a brake to produce a hem.

ϕ 5. Setting down hem on bar folder.

ϕ 6. Setting down hem on a brake.

INFORMATION

ϕ 1. Allowing enough material for bend.

TASK 15: FORMING DOUBLE HEM ON BAR FOLDER OR BRAKE FOR STRENGTH

MEASUREMENT

ø 1. Reading scale adjustment on bar folder for depth of bend.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

   a. Adding fractions to determine exact dimensions
   b. Subtracting fractions to determine exact dimensions

SKILLS

1. Operating a bar folder to produce a double hem.
2. Operating brake to produce a double hem.
3. Readjusting depth gage on bar folder for specific size double hem.

INFORMATION

ø 1. Allowing enough material for bends.

TASK 16: FORMING SINGLE SEAM ON A BRAKE AND/OR BAR FOLDER FOR JOINING SHEET METAL PARTS

MEASUREMENT

ø 1. Reading scale adjustment on bar folder for depth of bend.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

   a. Adding fractions to determine exact dimensions
   b. Subtracting fractions to determine exact dimensions

SKILLS

1. Operating a bar folder to produce a single seam.

ϕ 2. Aligning layout line with bending leaf.

3. Operating a brake to produce a single seam.

TASK 17: FORMING DOUBLE SEAM ON A BRAKE AND/OR BAR FOLDER FOR JOINING SHEET METAL PARTS

MEASUREMENT

ϕ 1. Reading scale adjustment on bar folder for depth of bend.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

   a. Adding fractions to determine exact dimensions
   b. Subtracting fractions to determine exact dimensions

SKILLS

1. Operating a bar folder to produce a double seam.

2. Operating a brake to produce a double seam.

TASK 18: FORMING THE PITTSBURGH LOCK SEAM WITH MACHINERY FOR JOINING SHEET METAL PARTS

MEASUREMENT

1. Determining overall dimensions of piece to be formed by adding material to form lock plus width of piece.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

   a. Adding fractions to determine exact dimensions
   b. Subtracting fractions to determine exact dimensions

SKILLS

ϕ 1. Adjusting machine for gauge metal to be fed.

2. Operating the Pittsburg Lock Seam Former.

TASK 19: FORMING CAP STRIP SEAM ON A DRIVE CAP MACHINE FOR JOINING SHEET METAL PARTS

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

   a. Adding fractions to determine exact dimensions
   b. Subtracting fractions to determine exact dimensions

SKILLS

ø 1. Adjusting machine for gauge metal to be feed.

2. Operating drive cap forming machine.

3. Cutting sheet metal to specific dimensions for feeding drive cap machine.

TASK 20: DRILLING SHEET METAL TO PRODUCE A FASTENER RECEIVER HOLE

COMMUNICATIONS

1. Reading blueprint to determine hole size to be drilled.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

   a. Adding fractions to determine exact dimensions
   b. Subtracting fractions to determine exact dimensions

* 2. Applying knowledge of decimals:

   a. Adding decimals to determine exact dimensions
   b. Subtracting decimals to determine exact dimensions
   c. Multiplying decimals to determine exact dimensions
   d. Dividing decimals to determine exact dimensions

SKILLS

Δ 1. Laying out sheet metal with:

  a. Rule and scale
  b. Scriber
  c. Combination square
  d. Center punch

2. Punching sheet metal with center punch for accurate drilling.

* 3. Installing drill in drill chuck.

Δ 4. Clamping sheet metal to drill press table.

* 5. Operating hand drill to produce a hole.

* 6. Operating drill press to produce a hole.

* 7. Removing burrs with an old drill.

INFORMATION

* 1. Selecting correct size drill for task to be performed.

TASK 21: ADHERING SHEET METAL PARTS WITH ADHESIVES TO PRODUCE AN ASSEMBLY

COMMUNICATIONS

* 1. Reading blueprints to determine:

  a. Adhesive to be used
  b. Surfaces to be bonded

MATHEMATICS

* 1. Calculating proportions of components of adhesive according to specifications.

* 2. Applying knowledge of weight and volume for mixing adhesive.

SKILLS

* 1. Cleaning surfaces to be bonded with appropriate cleaning solution.

* 2. Mixing adhesive compound according to procedure called for in specifications of adhesive.

3. Applying adhesive to area to be bonded according to specifications of adhesive.

Δ 4. Clamping metal bonded assembly in a manner appropriate to assembly and specifications of adhesive.

Δ 5. Removing clamping devices from bonded assembly.

INFORMATION

* 1. Selecting adhesive to be used for the sheet metal assembly.

TASK 22: WELDING (SPOT) SHEET METAL PARTS TO PRODUCE AN ASSEMBLY

COMMUNICATIONS

1. Reading blueprints to determine number and spacing of spot welds.

MEASUREMENT

Δ 1. Measuring with scale and marking pencil spots to be welded.

MATHEMATICS

* 1. Applying knowledge of decimals:

   a. Adding decimals to determine exact dimensions
   b. Subtracting decimals to determine exact dimensions
   c. Multiplying decimals to determine exact dimensions
   d. Dividing decimals to determine exact dimensions

SKILLS

* 1. Cleaning sheet metal area to be spot welded.

2. Adjusting spot welder for correct weld time and pressure.

Δ 3. Clamping metal assembly for spot welding.

4. Aligning tips of spot welder with areas to be welded.

Δ 5. Removing clamping devices form welded assembly.

TASK 23: SOLDERING SHEET METAL PARTS TO PRODUCE AN ASSEMBLY

COMMUNICATIONS

1. Reading blueprints to determine:
    a. Number of parts to be soldered
    b. Surfaces to be soldered

SKILLS

* 1. Cleaning surfaces to be soldered.

Δ 2. Clamping work to be soldered.

3. Tinning the soldering copper for efficient soldering practice.

4. Applying flux to the metal to be soldered.

5. Soldering sheet metal for assembly.

6. Testing soldered joint with water for leaks.

INFORMATION

1. Selecting most appropriate method of soldering for the task.

2. Selecting method of applying solder to specific joint.

3. Selecting appropriate solder for the job.

4. Selecting correct flux for the solder practice.

5. Selecting appropriate tinning solutions.

6. Selecting appropriate method of holding work to be soldered.

7. Handling acids with care for safety.

TASK 24: FASTENING SHEET METAL PARTS WITH SHEET METAL SCREWS TO PRODUCE AN ASSEMBLY

COMMUNICATIONS

1. Reading blueprints to determine size and number of sheet metal screws needed for the job.

SKILLS

* 1. Drilling correct size hole to accommodate screws to be used.

* 2. Punching sheet metal with center punch to start drill.

* 3. Fastening sheet metal parts with sheet metal screws.

INFORMATION

* 1. Selecting correct sheet metal screws for type and thickness of metal to be assembled.

* 2. Selecting correct tightening tool for screws to be used.

TASK 25: BOLTING SHEET METAL PARTS TO PRODUCE AN ASSEMBLY

COMMUNICATIONS

1. Reading blueprints to determine:
    a. Parts to be bolted
    b. Size of bolts required
    c. Type fit required
    d. Torque required

SKILLS

* 1. Fastening sheet metal parts with bolts.

INFORMATION

* 1. Selecting correct bolts for type and thickness of metal to be assembled.

* 2. Selecting correct tightening tool for bolts to be used.

3. Selecting correct washer to be used for assembly.

TASK 26: RIVETING SHEET METAL PARTS TO PRODUCE AN ASSEMBLY

COMMUNICATIONS

1. Reading blueprints to determine:
    a. Parts to be riveted
    b. Size of rivets
    c. Tip fit required
    d. Style head to be formed

SKILLS

* 1. Drilling correct size hole to accommodate rivets to be used.

* 2. Riveting sheet metal parts for assembly.

INFORMATION

* 1. Selecting correct riveting tools for the job:
    a. Hand
    b. Power

* 2. Selecting correct rivets to be used for type and thickness of metal to be assembled.

TASK 27: JOINING SHEET METAL PARTS WITH SEAMS

COMMUNICATIONS

1. Reading blueprints to determine specific seam (s) to be used in the assembly and their relationship.

SKILLS

1. Assembling sheet metal parts with seams.

2. Locking sheet metal seams for permanent assembly.

INFORMATION

1. Selecting parts to be mated by seams.

ASSEMBLY

TASK 1: ADHERING PARTS WITH ADHESIVES USING HAND PROCESSES TO PRODUCE A METAL BONDED ASSEMBLY

COMMUNICATIONS

* 1. Reading working drawing to determine:

  a. Adhesive to use
  b. Surfaces to be bonded

MATHEMATICS

* 1. Applying knowledge of weight and volume for mixing adhesives.

* 2. Calculating proportions of components of adhesive according to specifications.

SKILLS

* 1. Cleaning surfaces to be bonded with appropriate cleaning method:

  a. Chemical or acid bath
  b. Abrasive

2. Setting up metal assembly for bonding.

* 3. Mixing adhesive compound according to procedure called for in specification of the adhesive.

* 4. Applying adhesive to area to be bonded with hand tools.

Δ 5. Clamping metal bonded assembly in a manner appropriate to assembly and specifications of adhesive.

6. Cleaning hand tools used in applying adhesives with proper solvents.

Δ 7. Removing clamping devices from bonded assembly.

INFORMATION

* 1. Selecting appropriate hand tools for applying adhesive.

* 2. Selecting adhesive to be used for the metal bond assembly according to blueprint.

Δ 3. Selecting appropriate clamping devices for assembly.

* 4. Selecting appropriate mixing devices for assembly.

* 5. Practicing proper safety precautions as indicated on the specifications.

TASK 2: ADHERING PARTS WITH ADHESIVES USING SPRAY EQUIPMENT TO SPECIFIED THICKNESS TO PRODUCE A METAL BONDED ASSEMBLY

COMMUNICATIONS

* 1. Reading working drawing to determine:

   a. Adhesive to use
   b. Surfaces to be bonded

MATHEMATICS

* 1. Applying knowledge of weight and volume for mixing adhesives.

* 2. Calculating proportions of components of adhesive according to specifications.

SKILLS

* 1. Cleaning surfaces to be bonded with appropriate cleaning method:

   a. Chemical or acid bath
   b. Abrasive

2. Setting up metal assembly for bonding.

* 3. Mixing adhesive compound according to procedure called for in specification of the adhesive.

4. Filling spray chamber with adhesive.

5. Adjusting spray gun for proper spray density.

6. Spraying metal surfaces with adhesive spray gun to produce a metal bonded assembly.

Δ 7. Clamping metal bonded assembly in a manner appropriate to assembly and specification of adhesive.

8. Cleaning spray chamber with appropriate thinner.

Δ 9. Removing clamping devices from bonded assembly.

INFORMATION

1. Selecting appropriate equipment for applying adhesive.

* 2. Selecting adhesive to be used for the metal bond assembly according to blueprints.

Δ 3. Selecting appropriate clamping devices for assembly.

* 4. Selecting appropriate mixing devices for assembly.

* 5. Practicing proper safety precautions as indicated on the specifications.

TASK 3: FASTENING METAL PARTS WITH SCREW TO PRODUCE AN ASSEMBLY

COMMUNICATIONS

1. Reading blueprints to determine size and number of screws to be used.

SKILLS

1. Tightening screws with:

    a. Allen wrench
    * b. Phillips-head screwdriver
    * c. Standard screwdriver
    d. Offset screwdriver

INFORMATION

* 1. Selecting correct screws to be used for type and thickness of metal to be assembled.

* 2. Selecting correct tools to be used for assembling with screws.

TASK 4: BOLTING METAL PARTS WITH BOLTS TO PRODUCE AN ASSEMBLY

COMMUNICATIONS

1. Reading blueprints to determine size and number of bolts to be used.

SKILLS

1. Tightening appropriate metal fasteners with:

    a. Adjustable wrench.
    b. Torque wrenches
    c. Socket wrench (T-handle)
    d. Socket wrench (offset)
    e. Allen wrenches
    f. Socket wrench ratchet
    g. Open-end wrench
    h. Box-end wrench

INFORMATION

* 1. Selecting correct tools to be used for assembling with bolts.

* 2. Selecting correct bolts to be used for type and thickness of metal to be assembled.

TASK 5: RIVETING METAL PARTS TO PRODUCE AN ASSEMBLY

COMMUNICATIONS

1. Reading blueprints to determine size and number of rivets to be used.

SKILLS

* 1. Riveting metal parts with power tools to produce an assembly.

2. Punching rivets in assembly with a drift punch.

* 3. Riveting metal parts with hand tools to produce an assembly.

4. Setting rivets in an assembly.

INFORMATION

* 1. Selecting correct riveting tool for the job:

    a. Hand
    b. Power

* 2. Selecting correct rivet to be used for type and thickness of metal to be assembled.

TASK 6: TIGHTENING METAL FASTENERS WITH HAND POWER TOOLS

SKILLS

1. Mounting appropriate attachment to tighten or loosen metal fasteners.
2. Operating electric impact wrench to tighten or loosen metal fasteners.
3. Tightening appropriate metal fasteners with a reversible electric impact wrench.

INFORMATION

1. Selecting appropriate attachment to tighten or loosen metal fasteners.
2. Practicing proper safety precautions.

TASK 7: MATING PARTS TOGETHER TO PRODUCE SUB-ASSEMBLIES

COMMUNICATIONS

1. Reading blueprints (exploded view drawing) to determine relationship of detail parts to be mated.

SKILLS

1. Aligning mated parts for assembly with an aligning punch.

ϕ 2. Mating parts to produce a sub-assembly.

INFORMATION

ϕ 1. Selecting mated parts for the sub-assembly.

TASK 8: MATING PARTS AND SUB-ASSEMBLIES TOGETHER TO PRODUCE MAJOR ASSEMBLIES

COMMUNICATIONS

ϕ 1. Reading blueprints to determine relationship of details and sub-assemblies to produce major assemblies.

SKILLS

ϕ 1. Mating parts and sub-assemblies to produce major assemblies.

INFORMATION

1. Mating delicate parts with care.

ϕ 2. Selecting parts and sub-assemblies for mating.

TASK 9: HOLDING PARTS IN CLAMPING DEVICES FOR ASSEMBLY OF DETAILS, SUB-ASSEMBLIES, AND ASSEMBLIES

SKILLS

1. Holding round stock or pipe in pipe vise.

Δ 2. Holding work to bench with C-clamps.

Δ 3. Holding work in machinist's vise.

4. Installing sub-assemblies in jigs and fixtures for assembly.

Δ 5. Mounting work in swivel vise.

INFORMATION

1. Clamping work to appropriate tightness dependent upon the material and operation to be performed.

Δ 2. Selecting most appropriate vise for specific operation to be performed.

Δ 3. Selecting most appropriate clamps for specific operation to be performed.

TASK 10: CUTTING MATERIALS WITH HAND TOOLS TO FIT IN AN ASSEMBLY

COMMUNICATIONS

1. Reading blueprint to determine:

    Δ a. Size and characteristics of the workpiece
    Δ b. Type of cutting operation
    Δ c. Finish and accuracy required
    * d. Number of parts to be cut
    Δ e. Kind of material

2. Laying out stock with a:

    Δ a. Square
    Δ b. Rule or scale
    Δ c. Combination square
    Δ d. Dividers
    * e. Trammel points
    Δ f. Scriber

3. Cutting appropriate materials with diagonal cutting pliers.

4. Cutting bolts, rods, and heavy wire with bolt cutter to 1/32 of an inch.

5. Cutting metal (rivets, split nuts, ship castings and thin sheets) with cold chisel to 1/32 of an inch.

6. Cutting appropriate materials with side cutting pliers.

ø 7. Cutting metal tubing with tubing cutter to produce two pieces to 1/32 of an inch.

8. Cutting materials with combination pliers.

* 9. Cutting materials with hacksaw to 1/32 of an inch.

*10. Cutting materials with sheet metal snips (all types) to 1/32 of an inch.

11. Cutting materials with various types of chisels.

12. Cutting tubing with tubing cutters to 1/32 of an inch.

13. Cutting bolts with bolt cutter to 1/32 of an inch.

Δ 14. Removing burrs with:

  a. File
  b. Abrasive cloth

INFORMATION

* 1. Selecting appropriate cutting tool for task.

ɸ 2. Practicing keeping hands clear of cutting area.

ɸ 3. Cutting metals with sharp tools only.

TASK 11: CUTTING MATERIALS WITH POWER TOOLS TO FIT IN AN ASSEMBLY TO 1/32 OF AN INCH

COMMUNICATIONS

1. Reading blueprint to determine:

  Δ a. Size and characteristics of the workpiece
  Δ b. Size-drill bit
  Δ c. Finish and accuracy required
  * d. Number of parts to be cut
  Δ e. Kind of material

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

  a. Multiplying fractions to determine exact dimensions
  b. Adding fractions to determine exact dimensions
  c. Subtracting fractions to determine exact dimensions
  d. Dividing fractions to determine exact dimensions

SKILLS

1. Laying out stock with a:

  Δ a. Square
  Δ b. Rule or scale
  Δ c. Combination square
  Δ d. Dividers
  * e. Trammel points
  Δ f. Scriber
  Δ g. Center punch

- * 2. Cutting materials with sabre saw for assembly.
- * 3. Cutting materials with a nibbler saw for assembly.
- * 4. Sawing metal stock with hand hack saw to produce two pieces.

INFORMATION

- Δ 1. Selecting appropriate layout tools.
- 2. Selecting appropriate power tool for the task.
- ∅ 3. Practicing keeping hands away from cutting area.

TASK 12: FILING STOCK TO PRODUCE A FINISHED ASSEMBLY TO .001 OF AN INCH

SKILLS

- * 1. Files material with different shaped files to produce a flat surface.
- Δ 2. Files material with different shaped files to remove excess metal (deburrs).

INFORMATION

- Δ 1. Selecting correct file shape, size, and type of material to be filed.

TASK 13: DRILLING HOLES IN MATERIAL WITH HAND DRILL TO PRODUCE A HOLE TO .005 OF AN INCH

COMMUNICATIONS

- Δ 1. Reading blueprint to determine:
    - a. Size and characteristics of the workpiece to be drilled
    - b. Type of operation
    - c. Finish and accuracy required
    - d. Kind of material

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

a. Multiplying fractions to determine exact dimensions
b. Adding fractions to determine exact dimensions
c. Subtracting fractions to determine exact dimensions
d. Dividing fractions to determine exact dimensions

* 2. Applying knowledge of decimals:

a. Adding decimals to determine exact dimensions
b. Subtracting decimals to determine exact dimensions
c. Multiplying decimals to determine exact dimensions
d. Dividing decimals to determine exact dimensions

SKILLS

1. Laying out stock with a:

Δ a. Square
Δ b. Rule or scale
Δ c. Combination square
* d. Center head
* e. Hemaphrodite calipers
Δ f. Dividers
* g. Trammel points
Δ h. Scriber
Δ i. Center punch

* 2. Mounting drill bit in hand drill.

* 3. Drilling material with hand drill for assembly.

INFORMATION

* 1. Selecting hand drill most appropriate for task.

* 2. Selecting drill bit size according to working drawing.

∅ 3. Practicing keeping hands away from drilling area.

TASK 14: DRILLING STOCK WITH HAND POWER DRILLS TO PRODUCE A HOLE TO .005 OF AN INCH

COMMUNICATIONS

Δ 1. Reading blueprint to determine:

  - a. Size and characteristics of the workpiece to be drilled
  - b. Type of operation
  - c. Finish and accuracy required
  - d. Kind of material

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

  - a. Multiplying fractions to determine exact dimensions
  - b. Adding fractions to determine exact dimensions
  - c. Subtracting fractions to determine exact dimensions
  - d. Dividing fractions to determine exact dimensions

* 2. Applying knowledge of decimals:

  - a. Adding decimals to determine exact dimensions
  - b. Subtracting decimals to determine exact dimensions
  - c. Multiplying decimals to determine exact dimensions
  - d. Dividing decimals to determine exact dimensions

SKILLS

1. Laying out stock with a:

  - Δ a. Square
  - Δ b. Rule or scale
  - Δ c. Combination square
  - * d. Center head
  - * e. Hemaphrodite calipers
  - Δ f. Dividers
  - * g. Trammel points
  - Δ h. Scriber
  - Δ i. Center punch

* 2. Mounting drill bit in hand power drill.

* 3. Drilling materials with hand power drill for assembly.

INFORMATION

* 1. Selecting hand power drill most appropriate for the task.

* 2. Selecting drill bit size according to working drawing.

ø 3. Practicing keeping hands away from drilling area.

TASK 15: REAMING STOCK WITH HAND WRENCH TO PRODUCE A FINISHED HOLE TO .001 OF AN INCH

COMMUNICATIONS

1. Reading blueprint to determine:

   - Δ a. Size and characteristics of the workpiece
   - b. Size of reamer required
   - Δ c. Finish and accuracy required
   - * d. Number of parts
   - Δ e. Kind of material

MATHEMATICS

* 1. Applying knowledge of decimals:

   - a. Adding decimals to determine exact dimensions
   - b. Subtracting decimals to determine exact dimensions
   - c. Multiplying decimals to determine exact dimensions
   - d. Dividing decimals to determine exact dimensions

SKILLS

* 1. Mounting reamer in reamer wrench.

* 2. Reaming drilled hole to produce a finished hole to .001 of an inch.

INFORMATION

1. Selecting reamer wrench for the task.

* 2. Selecting correct size reamer for the task.

TASK 16: REAMING STOCK WITH HAND DRILL TO PRODUCE A FINISHED HOLE TO .001 OF AN INCH

COMMUNICATIONS

1. Reading blueprint to determine:

   - Δ a. Size and characteristics of the workpiece
   - b. Size reamer required

- Δ c. Finish and accuracy required
- * d. Number of parts to be reamed
- Δ e. Kind of material

MATHEMATICS

* 1. Applying knowledge of decimals:

- a. Adding decimals to determine exact dimensions
- b. Subtracting decimals to determine exact dimensions
- c. Multiplying decimals to determine exact dimensions
- d. Dividing decimals to determine exact dimensions

SKILLS

1. Mounting reamer in hand drill.

2. Reaming drilled holes with hand drill to produce a finished hole to .001 of an inch.

INFORMATION

* 1. Selecting appropriate hand drill for task.

* 2. Selecting correct size reamer for the task.

TASK 17: COUNTERSINKING HOLE WITH HAND TOOLS TO PRODUCE A FASTENER RECEIVER HOLE

COMMUNICATIONS

1. Reading blueprint to determine:

- Δ a. Size and characteristics of the workpiece
- Δ b. Type of operation
- Δ c. Finish and accuracy required
- * d. Number of parts to be countersunk
- Δ e. Kind of material

SKILLS

1. Mounting countersink in hand drill.

2. Countersinking drilled hole with countersink in hand drill to produce a fastener receiver hole.

INFORMATION

* * 1. Selecting appropriate hand drill for the task.
* * 2. Selecting proper countersink for the task.

TASK 18: COUNTERSINK HOLES WITH POWER DRILL TO PRODUCE A FASTENER RECEIVER HOLE

COMMUNICATIONS

1. Reading blueprint to determine:
    - Δ a. Size and characteristics of the workpiece
    - Δ b. Type of operation
    - Δ c. Finish and accuracy required
    - * d. Number of parts to be countersunk
    - Δ e. Kind of material

SKILLS

1. Mounting countersink in hand drill.
2. Countersinking drilled hole with countersink in power drill to produce a fastener receiver hole.

INFORMATION

* * 1. Selecting appropriate power drill for the task.
* * 2. Selecting proper countersink for the task.

TASK 19: TAPPING HOLES WITH TAPS TO PRODUCE A THREADED HOLE

COMMUNICATIONS

1. Reading blueprint to determine:
    - Δ a. Size and characteristics of the workpiece to be tapped
    - Δ b. Type of operation
    - Δ c. Finish and accuracy required
    - * d. Number of parts to be tapped
    - Δ e. Kind of material

MATHEMATICS

* 1. Applying knowledge of decimals:

   a. Adding decimals to determine exact dimensions
   b. Subtracting decimals to determine exact dimensions
   c. Multiplying decimals to determine exact dimensions
   d. Dividing decimals to determine exact dimensions

SKILLS

1. Mounting tap in tap wrench.

* 2. Applying cutting oil to the tapping operation.

3. Tapping a hole with a tap to produce a threaded hole.

4. Removing tap from finished hole.

INFORMATION

ø 1. Selecting appropriate tapping wrench for the task.

2. Selecting tap for task.

3. Tapping hole according to type of material.

TASK 20: CUTTING THREADS WITH DIES TO PRODUCE A THREADED MEMBER

COMMUNICATIONS

1. Reading blueprint to determine:

   Δ a. Size and characteristics of the workpiece to have threads cut
   Δ b. Type of operation
   Δ c. Finish and accuracy required
   * d. Number of parts to have threads cut
   Δ e. Kind of material

MATHEMATICS

* 1. Applying knowledge of decimals:

   a. Adding decimals to determine exact dimensions
   b. Subtracting decimals to determine exact dimensions

- c. Multiplying decimals to determine exact dimensions
- d. Dividing decimals to determine exact dimensions

SKILLS

1. Mounting die in die stock.

* 2. Applying oil to cutting process according to type of material being threaded.

3. Cutting stock with a die to produce external threads.

4. Removing die from finished external thread.

INFORMATION

1. Selecting appropriate wrench for holding die for task.

2. Selecting appropriate die for task.

3. Cutting threads according to type of material.

TASK 21: PUNCHING MATERIALS WITH HAND PUNCHES TO PRODUCE A HOLE

COMMUNICATIONS

1. Reading blueprint to determine:

    Δ a. Size and characteristics of the workpiece to be punched
    Δ b. Finish and accuracy required
    * c. Number of parts to be punched
    Δ d. Kind of material

SKILLS

1. Laying out stock with a:

    Δ a. Square
    Δ b. Rule or scale
    Δ c. Combination square
    Δ d. Dividers
    * e. Trammel points
    Δ f. Scriber
    Δ g. Center punch

2. Punching gasket materials with a gasket punch.

* 3. Punch light gauge metals with a hollow metal cutting punch.

ϕ 4. Aligning punch with layout lines and points for accurate punching.

INFORMATION

* 1. Selecting punch required for job.

2. Using punches which have had heads ground safely.

TASK 22: PUNCHING MATERIALS WITH POWER TOOLS TO PRODUCE A HOLE

COMMUNICATIONS

1. Reading blueprint to determine:

    Δ a. Size and characteristics of the workpiece to be punched
    Δ b. Finish and accuracy required
    * c. Number of parts to be punched
    Δ d. Kind of material

SKILLS

1. Laying out stock with a:

    Δ a. Square
    Δ b. Rule or scale
    Δ c. Combination square
    Δ d. Dividers
    * e. Trammel points
    Δ f. Scriber
    Δ g. Center punch

2. Operating power punch to produce holes.

ϕ 3. Aligning layout lines with punch for accurate punch.

INFORMATION

1. Practicing keeping hands away from punching area.

TASK 23: CHECKING DIMENSIONS OF DETAILS WITH PRECISION INSTRUMENTS FOR ACCURATE ASSEMBLY

COMMUNICATIONS

Δ 1. Reading blueprint to determine:

  a. Size of the workpiece
  b. Finish and accuracy required

MEASUREMENT

ø 1. Checking squareness of objects with a try square.

ø 2. Checking squareness of objects with a carpenter's square.

ø 3. Checking dimensions of details with divider to verify layout.

ø 4. Checking angles of objects with a combination square.

ø 5. Checking angles of objects with a sliding T-bevel.

* 6. Checking gauge of wire with wire gauge.

* 7. Checking gauge of sheet metal with wire gauge.

ø 8. Determining number of threads per inch with a thread gage.

* 9. Checking dimension of sub-assemblies for accuracy with a micrometer (inside and outside).

* 10. Checking dimensions for accuracy with outside calipers.

11. Checking dimensions for accuracy with form gauge block.

* 12. Checking dimensions for accuracy with inside calipers.

MATHEMATICS

ø 1. Calculating unknown dimensions from known dimensions to check for accuracy.

Δ 2. Applying knowledge of fractional parts of an inch:

  a. Multiplying fractions to determine exact dimensions
  b. Adding fractions to determine exact dimensions
  c. Subtracting fractions to determine exact dimensions
  d. Dividing fractions to determine exact dimensions

* 3. Applying knowledge of decimals:

- a. Adding decimals to determine exact dimensions
- b. Subtracting decimals to determine exact dimensions
- c. Multiplying decimals to determine exact dimensions
- d. Dividing decimals to determine exact dimensions

INFORMATION

* 1. Selecting appropriate precision instrument for dimensions to be checked.

* 2. Practicing safe instrument handing for accurate measurement.

TASK 24: CHECKING DIMENSIONS OF SUB-ASSEMBLIES AND ASSEMBLIES TO PRODUCE ACCURATE ASSEMBLIES

COMMUNICATIONS

Δ 1. Reading blueprint to determine:

- a. Size of the workpiece
- b. Finish and accuracy required

MEASUREMENT

ø 1. Checking squareness of objects with a try square.

ø 2. Checking squareness of objects with a carpenter's square.

ø 3. Checking dimensions of details with divider to verify layout.

ø 4. Checking angles of objects with a combination square.

ø 5. Checking angles of objects with a sliding T-bevel.

* 6. Checking gauge of wire with wire gauge.

* 7. Checking gauge of sheet metal with wire gauge.

ø 8. Determining number of threads per inch with a thread gage.

* 9. Checking dimension of sub-assemblies for accuracy with a micrometer (inside and outside).

* 10. Checking dimensions for accuracy with outside calipers.

11. Checking dimensions for accuracy with form gauge block.

* 12. Checking dimensions for accuracy with inside calipers.

MATHEMATICS

Ø 1. Calculating unknown dimensions from known dimensions to check for accuracy.

Δ 2. Applying knowledge of fractional parts of an inch:

   a. Multiplying fractions to determine exact dimensions
   b. Adding fractions to determine exact dimensions
   c. Subtracting fractions to determine exact dimensions
   d. Dividing fractions to determine exact dimensions

* 3. Applying knowledge of decimals:

   a. Adding decimals to determine exact dimensions
   b. Subtracting decimals to determine exact dimensions
   c. Multiplying decimals to determine exact dimensions
   d. Dividing decimals to determine exact dimensions

INFORMATION

* 1. Selecting appropriate precision instrument for dimensions to be checked.

* 2. Practicing safe instrument handing for accuracy measurement.

TASK 25: MEASURING STOCK WITH PRECISION INSTRUMENTS FOR ASSEMBLY

COMMUNICATIONS

Δ 1. Reading blueprints to determine dimensions of sub-assemblies and assemblies.

MEASUREMENT

Δ 1. Measuring objects with a tape rule to determine length.

Δ 2. Measuring objects with a steel rule to determine length.

Δ 3. Measuring objects with a steel tape to determine length.

Δ 4. Measuring objects with a folding tape to determine length.

Δ 5. Measuring objects with a hook rule to determine length.

* 6. Measuring outside and inside dimension of an object with vernier caliper to determine dimensions.

* 7. Measuring outside dimension of an object with an outside micrometer to determine dimension.

* 8. Measuring outside dimensions with outside calipers to determine dimension.

* 9. Measuring inside dimension of an object with an inside micrometer to determine dimension.

* 10. Measuring inside dimension of an object with inside calipers to determine dimension.

* 11. Measuring depth dimensions with a depth micrometer.

ø 12. Measuring screw threads with a screw thread micrometer.

ø 13. Measuring small openings with feelers gage to determine dimension.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

    a. Multiplying fractions to determine exact dimensions
    b. Adding fractions to determine exact dimensions
    c. Subtracting fractions to determine exact dimensions
    d. Dividing fractions to determine exact dimensions

* 2. Applying knowledge of decimals:

    a. Adding decimals to determine exact dimensions
    b. Subtracting decimals to determine exact dimensions
    c. Multiplying decimals to determine exact dimensions
    d. Dividing decimals to determine exact dimensions

INFORMATION

Δ 1. Selecting appropriate measuring devices for task.

* 2. Practicing safe instrument handling for accurate measurement.

TASK 26: STAMPING NUMBER AND LETTERS ON METAL STOCK FOR IDENTIFICATION

COMMUNICATIONS

1. Reading blueprints to determine style and size number and/or others to be stamped on items.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

   a. Multiplying fractions to determine exact dimensions
   b. Adding fractions to determine exact dimensions
   c. Subtracting fractions to determine exact dimensions
   d. Dividing fractions to determine exact dimensions

SKILLS

1. Laying out stock with a:

   Δ a. Square
   Δ b. Rule or scale
   Δ c. Combination square
   Δ d. Dividers
   * f. Trammel points
   Δ g. Scriber

2. Aligning numbers and/or letters with layout line.

3. Stamping numbers and/or letters on metal.

INFORMATION

1. Selecting number and/or letters to be used.

TASK 27: HAMMERING APPROPRIATE METAL PARTS WITH VARIOUS HAMMERS

SKILLS

1. Hammering appropriate material with:

   a. Ball peen hammer
   b. Straight peen hammer

c. Cross peen hammer
d. Soft faced hammer
e. Wooden hammer
f. Tack hammer

INFORMATION

1. Selecting appropriate hammer for job to be accomplished.
2. Recognizing the necessity of using a hammer with its head tight to handle.

TASK 28: FLARING METAL TUBING WITH FLARING TOOL TO PRODUCE A FLARE

SKILLS

1. Mounting tubing in tube-flaring tool.
2. Flaring metal tubing with tube flaring tool.

INFORMATION

1. Checking to see if burrs have been removed.
2. Checking to see if tubing has been cut squarely.
3. Selecting appropriate flaring tool for task.

TASK 29: ALIGNING PARTS IN SUB-ASSEMBLIES AND ASSEMBLIES WITH HAND TOOLS

COMMUNICATION

ø 1. Reading working drawing to determine parts relationships.

SKILLS

1. Aligning parts with an alignment punch.

INFORMATION

1. Selecting correct tool for aligning.

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INSTRUCTIONAL SEQUENCE EXAMPLE

METAL FORMING AND FABRICATION

This section of the report provides a suggested instructional sequence that may be utilized by the teacher in developing a lesson for each of the tasks listed in the task analysis section of the report. The task is shown at the top of the page with the headings for the areas of human requirement listed below the task. Under each heading the behavioral statements have been arranged in a suggested instructional sequence. The arrangement provides the teacher with an instructional pattern that can be used to develop lesson plans, materials of instruction, and visual aids.

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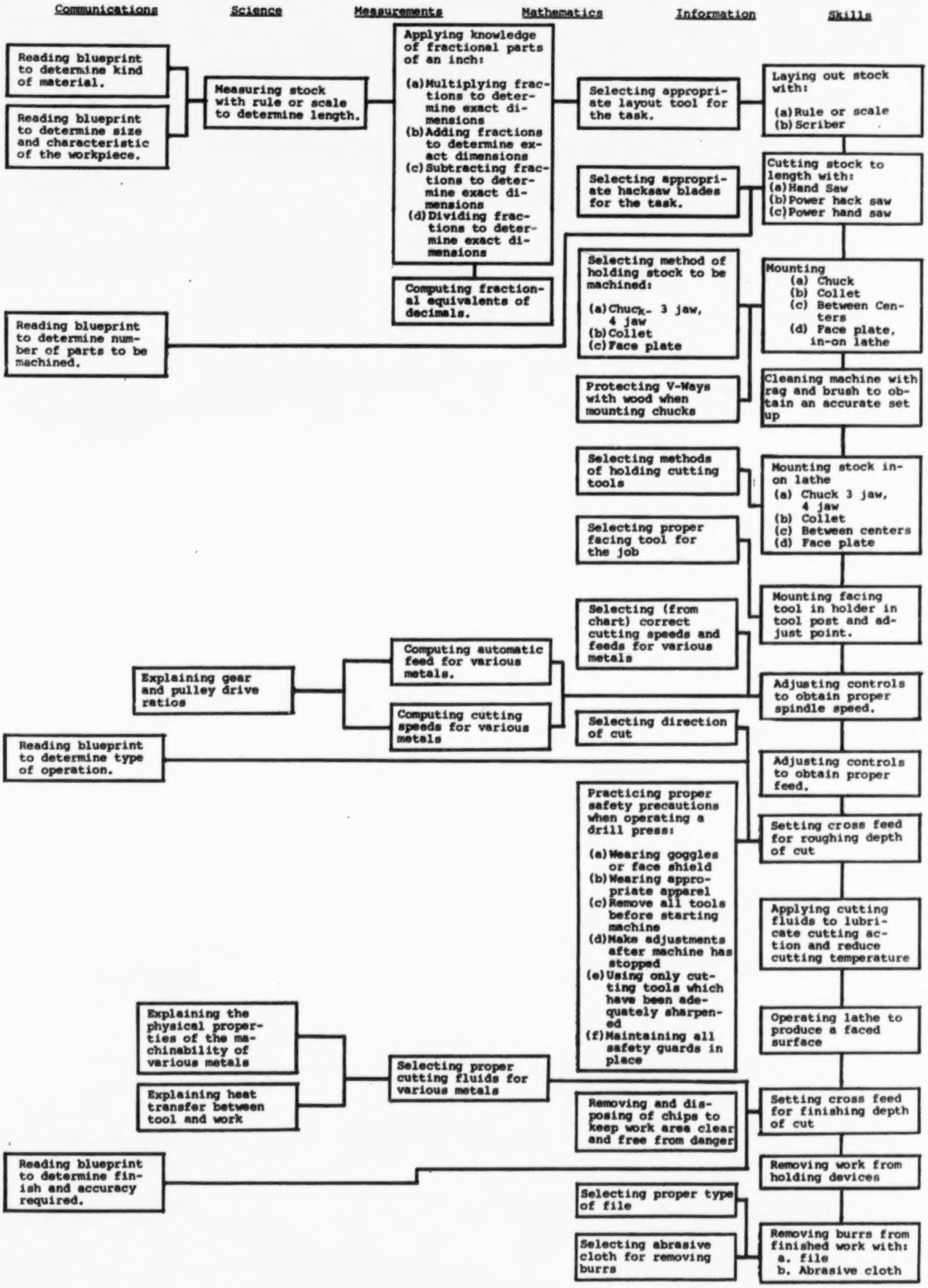
TURNING STOCK ON LATHE TO PRODUCE A FACED SURFACE


Communications
Science
Measurements
Mathematics
Information
Skills
Reading blueprint to determine kind of material.
Reading blueprint to determine size and characteristic of the workpiece.
Measuring stock with rule or scale to determine length.
Applying knowledge of fractional parts of an inch: (a) Multiplying fractions to determine exact dimensions (b) Adding fractions to determine exact dimensions (c) Subtracting fractions to determine exact dimensions (d) Dividing fractions to determine exact dimensions
Computing fractional equivalents of decimals.
Selecting appropriate layout tool for the task.
Laying out stock with: (a) Rule or scale (b) Scriber
Selecting appropriate hacksaw blades for the task.
Cutting stock to length with: (a) Hand Saw (b) Power hack saw (c) Power hand saw
Reading blueprint to determine number of parts to be machined.
Selecting method of holding stock to be machined: (a) Chuck- 3 jaw, 4 jaw (b) Collet (c) Face plate
Mounting (a) Chuck (b) Collet (c) Between Centers (d) Face plate, in-on lathe
Protecting V-Ways with wood when mounting chucks
Cleaning machine with rag and brush to obtain an accurate set up
Selecting methods of holding cutting tools
Mounting stock in-on lathe (a) Chuck 3 jaw, 4 jaw (b) Collet (c) Between centers (d) Face plate
Selecting proper facing tool for the job
Mounting facing tool in holder in tool post and adjust point.
Selecting (from chart) correct cutting speeds and feeds for various metals
Explaining gear and pulley drive ratios
Computing automatic feed for various metals.
Computing cutting speeds for various metals
Adjusting controls to obtain proper spindle speed.
Selecting direction of cut
Reading blueprint to determine type of operation.
Adjusting controls to obtain proper feed.
Practicing proper safety precautions when operating a drill press: (a) Wearing goggles or face shield (b) Wearing appropriate apparel (c) Remove all tools before starting machine (d) Make adjustments after machine has stopped (e) Using only cutting tools which have been adequately sharpened (f) Maintaining all safety guards in place
Setting cross feed for roughing depth of cut
Applying cutting fluids to lubricate cutting action and reduce cutting temperature
Operating lathe to produce a faced surface
Explaining the physical properties of the machinability of various metals
Explaining heat transfer between tool and work
Selecting proper cutting fluids for various metals
Removing and disposing of chips to keep work area clear and free from danger
Setting cross feed for finishing depth of cut
Reading blueprint to determine finish and accuracy required.
Removing work from holding devices
Selecting proper type of file
Selecting abrasive cloth for removing burrs
Removing burrs from finished work with: a. file b. Abrasive cloth

COMMON AREAS OF HUMAN REQUIREMENT

METAL FORMING AND FABRICATION

An inventory of skills and knowledges was compiled for each of the occupations in the metal forming and fabrication cluster. An analysis of these skills and knowledges was made to determine their frequency of appearance for each of the occupations in the cluster. The frequency of appearance is shown with respect to the following categories:

1. Common to all occupations.
2. Common to several occupations.

AREAS OF HUMAN REQUIREMENT COMMON TO ALL OCCUPATIONS IN THE METAL FORMING AND FABRICATION CLUSTER

AREAS OF HUMAN REQUIREMENT	MACHINIST	WELDER	SHEET METAL WORKER	ASSEMBLER
COMMUNICATION				
1. Reading blueprints to determine:				
a. Size and characteristics of work piece.	31	51	9	14
b. Material to be used.	31	52	9	9
c. Finish and accuracy.	27	52	9	14
d. Type of operation required . .	26	52	9	9
MEASUREMENT				
1. Measuring stock with a rule or scale . .	17	52	13	10
MATHEMATICS				
1. Applying knowledge of fractional parts of an inch:				
a. Adding fractions to determine exact dimensions.	25	52	19	7
b. Subtracting fractions to determine exact dimensions	25	52	19	7
c. Multiplying fractions to determine exact dimensions	25	52	19	7
d. Dividing fractions to determine exact dimensions.	25	52	19	7
SKILLS				
1. Laying out stock with a:				
a. Rule or scale.	18	51	9	7

AREAS OF HUMAN REQUIREMENT	MACHINIST	WELDER	SHEET METAL WORKER	ASSEMBLER
b. Square.	18	51	9	7
c. Combination square.	10	51	1	1
d. Dividers	17	51	9	6
e. Scriber	17	51	10	6
f. Center punch.	9	51	10	3
2. Mounting stock with clamps	17	51	4	3
3. Mounting stock in a vise	17	1	1	3
4. Removing burrs from stock with:				
a. File	23	52	9	1
b. Abrasive cloth	28	52	9	3
INFORMATION				
1. Selecting the appropriate layout for the task	18	51	9	7
2. Selecting the appropriate clamps for the task	17	51	4	3
3. Selecting the appropriate vise for the task	17	1	1	3
4. Selecting the appropriate file for the task	23	52	9	1
5. Selecting the appropriate abrasive cloth for the task	28	52	9	3

AREAS OF HUMAN REQUIREMENT COMMON TO SEVERAL OCCUPATIONS IN THE METAL FORMING AND FABRICATION CLUSTER

AREAS OF HUMAN REQUIREMENT	MACHINIST	WELDER	SHEET METAL WORKER	ASSEMBLER
COMMUNICATION				
1. Reading blueprints to determine the number of parts.	31	52	0	10
MEASUREMENT				
1. Measuring stock on workpiece with:				
a. Outside micrometer	13	0	10	3
b. Inside micrometer.	3	0	0	3
c. Outside calipers	5	0	0	3
d. Inside calipers	3	0	0	3
e. Vernier calipers	6	0	0	1
MATHEMATICS				
1. Applying knowledge of decimals:				
a. Adding decimals to determine exact dimensions	24	0	12	9
b. Subtracting decimals to determine exact dimensions	24	0	12	9
c. Multiplying decimals to determine exact dimensions	24	0	12	9
d. Dividing decimals to determine exact dimensions	24	0	12	9
2. Calculating proportions of components of adhesive according to specification	0	0	1	2

AREAS OF HUMAN REQUIREMENT	MACHINIST	WELDER	SHEET METAL WORKER	ASSEMBLER
SKILLS				
1. Laying out stock with a:				
a. Center head	8	51	0	2
b. Hermaphrodite calipers	8	51	0	1
c. Surface gauge	16	51	0	0
d. Trammel points	0	51	9	3
2. Cleaning metal parts with appropriate cleaning solution	0	52	3	2
3. Cutting stock with a hand hack saw	19	50	0	11
4. Cutting stock with a power hack saw	19	50	0	0
5. Cutting stock with a band saw	19	50	0	0
6. Cutting stock with aviation snips	0	0	5	1
7. Cutting stock with combination snips	0	0	4	1
8. Cutting stock with a portable power shear	0	0	2	1
9. Drilling stock with a hand drill to produce a hole	0	0	3	1
10. Drilling stock with a drill press to produce a hole	1	0	3	0
11. Removing burrs with an old drill	7	0	1	0
12. Riveting stock with riveting tools to produce an assembled unit	0	0	1	1
13. Bolting parts to produce an assembled unit	0	0	1	2
14. Fastening metal parts with sheet metal screws	0	0	1	1

AREAS OF HUMAN REQUIREMENT	MACHINIST	WELDER	SHEET METAL WORKER	ASSEMBLER
INFORMATION				
1. Selecting appropriate hack saw blades for the task.	19	50	0	1
2. Selecting drill bits for drilling holes. .	2	0	1	2
3. Selecting appropriate screws for the task .	0	0	1	1
4. Selecting appropriate bolts for the task .	0	0	1	1
5. Selecting appropriate rivets for the task .	0	0	1	1
6. Selecting appropriate adhesive for the task	0	0	1	2
7. Selecting appropriate cutting tools for the task	0	0	5	1
8. Practicing proper safety precautions:				
a. Wearing goggles or face shield .	33	52	0	0
b. Wearing appropriate apparel . .	33	52	9	0

COURSE OUTLINE

METAL FORMING AND FABRICATION

This section of the report includes the course outline for the metal forming and fabrication cluster. The course outline is divided into a first and second level program. Units of instruction have been developed that provide the manipulative and verbal learnings required for job entry into each of the occupations found in the cluster. A list of suggested learning activities has been provided for each unit as well as a list of instructional materials for each occupational area.

COURSE DESCRIPTION: The course outline for the occupational cluster of metal forming and fabrication is designed to be used in a cluster concept program in vocational education at the secondary school level. The program is aimed at the development of skills and understandings related to a group of occupations within the metal forming and fabrication cluster. It is not an in-depth development into any one occupation, but aims at preparing students to enter a range of occupations within the metal forming and fabrication cluster.

NEED FOR THE COURSE: The course is designed to meet the needs of students pursuing a general curriculum in the secondary school system by providing job entry skills in a number of related occupations. It is also designed to meet the student's need for self appraisal of interests and potentialities in a number of occupations:

Specific needs include the following:

1. To provide students with the opportunity for a greater degree of mobility on a geographical basis.
2. To provide students with the opportunity for mobility within an industry or occupation.
3. To provide students with the opportunity for greater flexibility in occupational choice patterns.
4. To develop students who will be adaptable to technological changes.

COURSE OBJECTIVES: The course for the metal forming and fabrication cluster will be directed toward the following objectives:

1. To broaden the student's knowledge of the

available opportunities in the occupations found in the metal forming and fabrication cluster.

2. To develop job entry skills and knowledge for several occupations found in the metal forming and fabrication cluster.

3. To develop safe habits and a favorable attitude toward work in the metal forming and fabrication cluster.

4. To develop a student's insight into the sources of information that will be helpful to him as he moves through the occupational areas.

The specific objectives for the course are the following:

1. To develop the student's competency in the use of common hand tools found in the metal forming and fabrication cluster.

2. To develop the student's competency in using power tools and equipment needed for job entry into the occupations found in the metal forming and fabrication cluster.

3. To develop the student's understanding of the operations, procedures, and processes associated with the metal forming and fabrication cluster.

4. To develop safe working habits related to the occupations within the metal forming and fabrication cluster.

5. To familiarize the student with the terminology associated with the metal forming and fabrication cluster.

6. To develop an understanding of the resources available to him in his pursuit of the course as well as in his work following graduation.

PROCEDURE: It is recommended that the course be offered during the student's junior and senior year in high school. Instruction should be provided for two periods a day, five days a week, during the school year. The Level I experiences were designed for the junior year (or first year) program and the Level II experiences were designed for the second year or senior year program.

The most appropriate facility would be a self-contained laboratory unit containing the essential tools and equipment necessary for teaching job entry tasks in the metal forming and fabrication cluster.

The instructor should be a person with some experience and competence in the occupations included in the cluster. The course should be organized by the teacher on a multiple activity basis with groups of students rotating through the specific occupational areas. The common areas of human requirement needed to perform the tasks in the cluster should be emphasized so that an opportunity is provided for the students to transfer the common skill or knowledge from one occupation to another.

The possibility of team teaching procedures would be appropriate for the metal forming and fabrication cluster. Specialists in the different occupational areas would participate in the instructional program. The team teachers could be other vocational teachers as well as competent individuals from the community.

The instructor of the course should coordinate his program with other teachers in the school to develop the competencies in mathematics, science, and communication that will be needed for successful performance in the occupations found in the metal forming and fabrication cluster. Community resources, such as local industries, employment agencies, and tradesmen should be utilized to provide occupational information and knowledge needed concerning the performance of the tasks in the metal forming and fabrication cluster.

The course should be supplemented with field trips, films, and other educational media. A suggested list is provided at the end of each occupational area in the course outline.

LEVEL I EXPERIENCES

FIRST YEAR PROGRAM

MACHINING EXPERIENCES - - LEVEL I

Unit I

Title: Machining Activities Associated With the Lathe

Objective: To develop in the individual the capability to perform the following operations on the lathe: facing, countersinking and center drilling, cylinder turning, shoulder turning, drilling, reaming, and filing.

Manual or Manipulative Learning:

A. Laying out stock with: (square, rule or scale, combination square, center head, hermaphrodite calipers, surface guage, dividers, trammel points, scriber, center punch).
B. Cutting stock to length with: (hand saw, power hack saw, power band saw).
C. Cleaning machine to obtain an accurate set up.
D. Mounting (chuck, collet, face plate, centers) on lathe.
E. Aligning centers to produce an accurate cut.
F. Applying lubricant to the dead centers on the lathe.
G. Mounting stock on the lathe with: (chuck, 3 or 4 jaw, collet, face plate, between centers).
H. Mounting cutting tool in holder.
I. Adjusting controls to obtain proper spindle speed.

Verbal Learning:

Communication:

A. Reading blueprints to determine: (size, and characteristics of work piece, type of operation, finish and accuracy required, number of parts to be machined, and kind of material.

Measurement:

A. Measuring stock to determine size with: (rule or scale, outside calipers, micrometer, inside and outside, plug gauge).
B. Reading graduations on tail stock to determine depth of the hole.

Mathematics:

A. Applying knowledge of fractions (adding, subtracting, multiplying, dividing).

J. Adjusting controls to obtain proper feed.
K. Setting depth of cut for roughing.
L. Apply cutting fluids to lubricate cutting action and reduce cutting temperature.
M. Facing stock on the lathe to produce a faced surface.
N. Countersinking (countersink and center drill) on lathe to produce a tapered hole for mounting stock between centers.
O. Turning stock on lathe to produce a cylinderical shape to .001 of an inch.
P. Turning stock on the lathe to produce a shoulder to .001 of an inch.
Q. Drilling stock on lathe to produce a hole to .005 of an inch
R. Reaming stock on lathe to produce a finished hole to .001 of an inch.
S. Filing stock on lathe to produce a finished surface.
T. Setting depth of cut for finished cut.
U. Removing work from holding devices.
V. Removing burrs

B. Applying knowledge of decimals (adding, subtracting, multiplying, dividing).
C. Computing fractional equivalents of decimals and decimal equivalents of fractions.
D. Computing feeds and speeds for various metals.
E. Determining decimal and fractional equi equivalents from chart.

Science:

A. Explaining gear and pulley drive ratios.
B. Explaining heat transfer as it relates to coolants.
C. Explaining the physical properties and the machinability of various metals.
D. Explaining the heat generated on the dead center of the lathe.

General Information

A. Selecting appropriate layout tools for the task.
B. Selecting appropriate hacksaw blades for the task.
C. Selecting method of holding work to be machined (chuck, 4 or 3 jaw, collet, face plate, between centers)
D. Protecting V-ways with wood when mounting chucks.
E. Selecting proper cutting tool for the job.
F. Selecting method of holding cutting tool.
G. Selecting from chart correct cutting speeds for various metals.

H. Selecting direction of cut.
I. Removing and disposing of chips to keep work area clear and free from danger.
J. Practicing proper safety precautions when operating a lathe: (wearing goggles or face shield, wearing appropriate apparel, removing all tools before starting machine, making adjustments after machine has stopped, using only sharpened tools, maintaining all safety guards.
K. Selecting proper cutting fluids.
L. Selecting proper lubricant for dead center.
M. Selecting proper type of file.
N. Selecting proper abrasive cloth.

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Turning a faced surface on the lathe.
B. Turning a cylinder on the lathe between centers.
C. Computing fractional and decimal equivalents from charts.
D. Computing cutting speeds and feeds for various metals on the lathe.
E. Turning a finished shoulder on the lathe.
F. Machining a part that has a reamed finished hole.
G. Measuring and cutting stock to length.
H. Reading blueprints to determine characteristics of parts to be machined.
I. Changing gears and pulley drives on the lathe.
J. Practicing reading the micrometer to develop competance in its use.
K. Turning various metals on the lathe to determine their machinability characteristics.

MACHINING EXPERIENCES - - LEVEL I

Unit II

Title: Machining Activities Associated With the Drill Press

Objective: To develop in the individuals the capability to perform the following operations on the drill press: drilling, reaming, countersinking.

Manual or Manipulative Learning:

A. Cutting stock to length with: (hand saw, power hacksaw, power band saw).
B. Laying out stock with: (square, rule or scale, combination square, center head, hemaphrodite calipers, surface gauge, dividers, trammel points, scriber, center punch.
C. Mounting cutting tools in drill press.
D. Adjusting controls to obtain proper spindle speeds.
E. Mounting holding device on drill press (vise, vee block, clamps, angle plate, jigs and fixtures).
F. Cleaning machine with rag and brush for accurate set up.
G. Mounting work in holding devices: (vise, vee blocks, clamps, angle plate, jigs and fixtures).
H. Adjusting depth stop for specific depth hole.
I. Positioning stop blocks for multiple drilling of parts.

Verbal Learning:

Communication:

A. Reading blueprints to determine: (size and characteristic of part, size and depth of hole, number of parts to be drilled, reamed or countersunk and accuracy required).

Measurement:

A. Measuring hole with: (inside micrometer, plug gauge, or telescopic gauge).

Mathematics:

A. Applying knowledge of fractions (adding, subtracting, multiplying, dividing).
B. Applying knowledge of decimals (adding, subtracting, multiplying, dividing).
C. Computing fractional equivalents of decimals and decimal equivalents of fractions.

J. Centering work with respect to spindle.
K. Aligning center punch mark with drill.
L. Drilling stock to produce a hole.
M. Reaming hole to produce a finished hole.
N. Countersinking hole to produce a fastener receiver hole.
O. Applying cutting fluid to lubricate cutting action and reduce cutting temperature.
P. Removing work from holding devices.
Q. Removing burrs from work with abrasive cloth or old drill.

Science:

A. Explaining pulley drive ratios.
B. Explaining heat transfer as it relates to coolants.
C. Explaining the physical properties and the machinability of various metals.

General Information

A. Selecting appropriate layout tools for the task.
B. Selecting appropriate hacksaw blades for the task.
C. Selecting proper drill, reamer, or countersind according to specifications.
D. Selecting from charts proper speeds for various metals.
E. Selecting method of holding stock to be machined: (vises, vee blocks, clamps, angle plate, jigs and fixtures).
F. Removing and disposing of chips to keep work area clear and free from danger.
G. Practicing proper safety precaution when operating a lathe: (wearing goggles or face shield, wearing appropriate apparel, removing all tools before starting machine, making adjustments after machine has stopped, using only sharpened tools, maintaining all safety guards.
H. Selecting proper cutting fluids for various metals.
I. Adjusting table for angular drilling.
J. Selecting abrasive cloth for removing burrs.

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Reading blueprints to determine characteristics of parts to be machined.
B. Measuring the dimensions of various size holes with inside micrometer.
C. Computing fractional and decimal equivalents.
D. Machining stock to produce a countersunk hole with a finished surface.
E. Changing the belts on the pulley drive.
F. Drilling various kinds of metals to determine machinability characteristics.
G. Checking the squareness of the drill with the bed of the table with a square.

MACHINING EXPERIENCES - - LEVEL I

Unit III

Title: Machining Activities Performed on the Bench Grinder.

Objective: To develop an individuals capability to perform the following operations on the bench grinder: removing excess metal and sharpening tools.

Manual or Manipulative Learning:

A. Grinding excess metal.
B. Removing burrs from finished work with a file or abrasive cloth.
C. Grinding scriber to correct point.
D. Mounting drill in drill bit attachment.
E. Grinding drill bits to specified angles and clearances.
F. Grinding lathe tools to correct angles and clearances.
G. Grinding various shaped chisels on a grinder to correct angles.
H. Grinding center punch to correct angle.

Verbal Learning:

Communications:

A. Reading blueprints to determine: (surfaces to be ground, dimensions, type finish required).
B. Reading working drawing, blueprint, or text to determine angles tools are to be sharpened.

Measurement:

A. Checking drill bit angles with a drill bit gauge.
B. Checking angle of center punch with a center gauge.
C. Measuring stock with: (vernier calipers, outside calipers, and scale, outside micrometer).

Mathematics:

A. Applying knowledge of angles.

Science:

A. Explaining the physical properties and the machinability of various metals.

General Information

A. Practicing proper safety precautions when operating a lathe: (wearing goggles or face shield, wearing appropriate apparel, removing all tools before starting machine, making adjustments after machine has stopped, using only sharpened tools, maintaining all safety guards.
B. Selecting proper grinding wheel appropriate for finish called for from working drawing.
C. Applying knowledge of cutting angles for specific materials.

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Grinding old drills to various angles and testing their machining qualities.
B. Checking various tool angles in tool cabinet against specifications for those tools.
C. Reading drawings, texts and blueprints for correct angles for tools.
D. Grinding materials under specified pressures testing the heat generated with a contact thermometer.

MACHINING EXPERIENCES - - LEVEL I

Unit IV

Title: Machining Activities Performed on the Shaper.

Objective: To develop in the individual the capability to perform the following operations on the shaper: machining a flat surface and machining parallel surfaces.

Manual or Manipulative Learning:

A. Laying out stock with: (square, rule or scale, surface gauge, dividers, scriber, center punch).
B. Cutting stock to length with: (hand saw, power hack saw, power band saw).
C. Cleaning machine to obtain an accurate setup.
D. Mounting stock on shaper with clamps or in vise.
E. Mounting cutting tool in tool holder.
F. Adjusting position of ram according to size of material being machined.
G. Adjusting length of the stroke of the ram.
H. Adjusting controls to obtain proper ram speed and feed of shaper according to size and type of material being machined.
I. Aligning cutting tool with stock to be machined according to angle and depth of cut.

Verbal Learning:

Communication:

A. Reading blueprints to determine: (size and characteristics of work piece, type of operation, finish and accuracy required number of parts to be machined, and kind of material.

Measurement:

A. Measuring stock to determine size with: (rule or scale, outside micrometer).
B. Reading graduations on cross feed screw to determine depth of cut.

Mathematics:

A. Applying knowledge of fractions (adding, subtracting, multiplying, dividing).
B. Applying knowledge of decimals (adding, subtracting, multiplying, dividing).
C. Computing ram speed and feed of shaper according to size and type of material being machined.

J. Setting depth of cut for roughing cut.
K. Machining a flat surface.
L. Machining two parallel surfaces.
M. Setting depth of cut for finished cut.
N. Removing work from holding devices.
O. Removing burrs from finished work with a file or abrasive cloth.

Science:

A. Explaining the physical properties and the machinability of various metals.
B. Explaining heat transfer as it relates to coolants.

General Information

A. Selecting appropriate layout tools for the task.
B. Selecting appropriate hacksaw blades for the task.
C. Selecting method of mounting work: (vise or clamps).
D. Selecting proper cutting tools for the job.
E. Removing and disposing of chips to keep work area clear and free from danger.
F. Practicing proper safety precautions when operating a lathe: (wearing goggles or face shield, wearing appropriate apparel, removing all tools before starting machine, making adjustments after machine has stopped, using only sharpened tools, maintaining all safety guards.
G. Selecting proper type of file.
H. Selecting proper abrasive cloth.

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Reading blueprints to determine characteristics of part.
B. Measuring machined parts with a micrometer for practice.
C. Checking accuracy of cross feed screw by measuring stock before machining and after, counting number of turns of screw.
D. Checking heat generated with a contact thermometer at different depths of cut and different speeds.
E. Checking safety practiced by different students against established standards.
F. Computing the cutting feeds and speeds for various metals and compare them with chart ratings.
G. Measuring and cutting stock to length.

MACHINING EXPERIENCES - - LEVEL I

Unit V

Title: Occupational Information Pertaining to Machining and Related Occupations.

Objective: To acquaint the individual with the opportunities in machining and related occupations.

Occupational Information

Obtaining information about:

A. The employment outlook.
B. The wages scale.
C. The types of training available.
D. The working conditions experienced in the occupation.
E. The physical and mental characteristics needed for qualification for employment.
F. The geographical location of employment.
G. The opportunities for advancement.
H. The advantages and disadvantages of the occupation.
I. The nature of the work involved in the occupation.
J. The union involvement in the occupation.
K. The means of entry into the occupation.

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Writing specific information concerning opportunities in the occupations of the metal forming and fabrication cluster.
B. Visiting an office of the State Employment Service.
C. Listening to a speaker from a trade union.
D. Writing letters to correspondence and trade schools in order to determine opportunities for additional training.
E. Visiting a school for apprentices.
F. Visiting a machining industry.
G. Watching movies on machining activities.
H. Reading the Occupational Outlook Handbook.

LEVEL II EXPERIENCES

SECOND YEAR PROGRAM

MACHINING EXPERIENCES --- LEVEL II

Unit I

Title: Machining Activities Performed on the Lathe.

Objective: To develop in the individual the capability to perform the following operations on the lathe: boring, counterboring, parting and necking.

Manual or Manipulative Learning:

A. Laying out stock with: (square, rule or scale, combination square, center head, hermaphrodite calipers, surface gauge, dividers, trammel points, scriber, center punch).
B. Cutting stock to length with: (hand saw, power hack saw, power band saw).
C. Cleaning machine to obtain an accurate setup.
D. Mounting (chuck, collet, face plate, centers) on lathe.
E. Applying lubricant to the dead centers on the lathe.
F. Mounting stock on the lathe with: (chuck, 3 or 4 jaw, collet, face plate, between centers).
G. Mounting cutting tool in holder.
H. Adjusting controls to obtain proper spindle speed.
I. Adjusting controls to obtain proper feed.

Verbal Learning:

Communication:

A. Reading blueprints to determine: (size and characteristics of work piece, type of operation, finish and accuracy required number of parts to be machined, and kind of material.

Measurement:

A. Measuring stock to determine size with: (rule or scale, outside calipers, micrometer, inside).
B. Reading graduations on tail stock to determine depth of the hole.

Mathematics:

A. Applying knowledge of fractions (adding, subtracting, multiplying, dividing).
B. Applying knowledge of decimals (adding, subtracting, multiplying, dividing).
C. Computing fractional equivalents of decimals and decimal equivalents of fractions.

J. Setting depth of cut for roughing.
K. Apply cutting fluids to lubricate cutting action and reduce cutting temperature.
L. Boring stock on the lathe to produce an enlarged hole to .001 of an inch.
M. Counterboring stock on the lathe to produce a recessed hole to .001 of an inch.
N. Parting stock on the lathe to produce a piece within 1/32 of an inch in length.
O. Necking stock on lathe to produce a necked shape to 1/32 of an inch.
P. Setting depth of cut for finished cut.
Q. Removing work from holding devices.
R. Removing burrs.

D. Computing feeds and speeds for various metals.
E. Determining decimal and fractional equivalents from chart.

Science:

A. Explaining gear and pulley drive ratios.
B. Explaining heat transfer as it relates to coolants.
C. Explaining the physical properties and the machinability of various metals.
D. Explaining the heat generated on the dead center of the lathe.

General Information

A. Selecting appropriate layout tools for the task.
B. Selecting appropriate hacksaw blades for the task.
C. Selecting method of holding work to be machined (chuck, 4 or 3 jaw, collet, face plate, between centers).
D. Protecting V-ways with wood when mounting chucks.
E. Selecting proper cutting tool for the job.
F. Selecting method of holding cutting tool.
G. Selecting from chart correct cutting speeds for various metals.
H. Selecting direction of cut.
I. Removing and disposing of chips to keep work area clear and free from danger.
J. Practicing proper safety precaution when operating a lathe: (wearing goggles or face shield, wearing appropriate apparel, removing all tools before starting machine, making adjustments after machine has stopped, using only sharpened tools, maintaining all safety guards.

K. Selecting proper cutting fluids.
L. Selecting proper lubricant for dead center.
M. Selecting proper type of file.
N. Selecting proper abrasive cloth.

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Boring stock on lathe to produce an enlarged hole.
B. Counterboring stock on lathe to produce a recessed hole.
C. Parting stock on the lathe.
D. Necking stock on lathe to produce a necked shape.
E. Computing fractional and decimal equalants.
F. Reading graduations on tail stock to determine depth of cut.
G. Applying coolants to different metals while being machined and measuring the cutting temperature with a contact thermometer at specified cutting depths.
H. Computing feeds and speeds for various metals.

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Unit II

Title: Machining Activities Performed on the Drill Press.

Objective: To develop in the individual the capability to perform the following operations on the drill press: spot facing and counterboring.

Manual or Manipulative Learning:

A. Mounting cutting tools in drill press.
B. Adjusting controls to obtain proper spindle speeds.
C. Mounting holding device on drill press (vise, vee block, clamps, angle plate, jigs and fixtures).
D. Cleaning machine with rag and brush for accurate setup.
E. Adjusting depth stop for specific depth hole.
F. Positioning stop blocks for multiple machining of parts.
G. Centering work with respect to spindle.
H. Spotfacing stock to produce a finished surface.
I. Counterboring stock to produce an enlarged hole.
J. Applying cutting fluid to lubricate cutting action and reduce cutting temperature.

Verbal Learning:

Communication:

A. Reading blueprints to determine: (size and characteristics of part, size and depth of hole, number of parts to be spot faced or counterbored, and accuracy required.

Mathematics:

A. Applying knowledge of fractions (adding, subtracting, multiplying, dividing).
B. Applying knowledge of decimals (adding, subtracting, multiplying, dividing).
C. Computing fractional equivalents of decimals and decimal equivalents of fractions.

Science:

A. Explaining pulley drive ratios.
B. Explaining heat transfer as it relates to coolants.

K. Removing work from holding devices.
L. Removing burrs from work with abrasive cloth or old drill.

C. Explaining the physical properties and the machinability of various metals.

General Information

A. Selecting proper spot facing tool or counterboring tool according to specifications.
B. Selecting from charts proper speeds for various metals.
C. Removing and disposing of chips to keep work area clear and free from danger.
D. Practicing proper safety precautions when operating a lathe: (wearing goggles or face shield, wearing appropriate apparel, removing all tools before starting machine, making adjustments after machine has stopped, using only sharpened tools, maintaining all safety guards.
E. Selecting proper cutting fluids for various metals.
F. Selecting abrasive cloth for removing burrs.

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Reading blueprints to determine characteristics of parts to be machined.
B. Computing fractional and decimal equivalents.
C. Measuring the heat generated with a contact thermometer as it is transferred from the cutting area to the outer portions of the part being machined.
D. Checking to determine whether the safety precautions practiced on an operation meet with established safety standards.
E. Checking with an RPM meter the speeds used by students for a particular operation against established ratings for the specific job.

Unit III

Title: Grinding Activities Associated With the Surface Grinder

Objective: To develop in the individual the capability to perform the following operations on the surface grinder: grinding a flat surface, grinding parallel surfaces, grinding two perpendicular surfaces, grinding angular surfaces.

Manual or Manipulative Learning:

A. Testing soundness of wheel by striking a light blow with hammer.
B. Mounting grinding wheel on spindle of surface grinder.
C. Truing and dressing a grinding wheel with a truing fixture.
D. Mounting work on surface grinder with: (clamps, vise, magnetic surface).
E. Mounting stock with: (parallels, angle plate, vee blocks, shims, step blocks).
F. Aligning grinding wheel with work to be ground.
G. Setting depth of cut for roughing cut.
H. Grinding a flat surface on a surface grinder.
I. Grinding two parallel surfaces on a surface grinder.

Verbal Learning:

Communication:

A. Reading blueprints to determine: (size and characteristics of work piece, type of operation, finish and accuracy required number of parts to be machined, and kind of material.

Measurement:

A. Measuring stock to determine size with: micrometer.
B. Reading graduations on vertical adjustment hand wheel.
C. Measuring angular surfaces with a sine bar.

Mathematics:

A. Applying knowledge of decimals (adding, subtracting, multiplying, dividing).

J. Grinding two perpendicular surfaces on a surface grinder.
K. Grinding angular surfaces on a surface grinder.
L. Adjusting power cross feed for automatic operation.
M. Applying cutting fluid to lubricate grinding action and reduce cutting temperature.
N. Setting depth of cut for finishing cut.
O. Removing work from holding devices.
P. Removing burrs from finished work with a file or abrasive cloth.

B. Computing fractional equivalents of decimals.
C. Determining decimal equivalents of work piece from chart.
D. Calculating cutting speeds and feeds for grinding.
E. Applying knowledge of angles.

Science:

A. Explaining the physical properties the machinability of various metals.
B. Explaining heat transfer as it relates to coolants.

General Information

A. Selecting grinding wheel most appropriate for task.
B. Selecting method of holding work to be machined: (vise, clamps, magnetic surface).
C. Practicing proper safety precaution when operating a lathe: (wearing goggles or face shield, wearing appropriate apparel, removing all tools before starting machine, making adjustments after machine has stopped, using only sharpened tools, maintaining all safety guards.
D. Selecting proper cutting fluids for grinding.
E. Selecting proper longitudinal and cross feeds for grinding.
F. Selecting proper type of file.
G. Selecting proper abrasive cloth.

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Grinding on the surface grinder a part that incorporates the finishing of flat surfaces, parallel surfaces, two perpendicular surfaces and angular surfaces.
B. Measuring different angular surfaces with a sine bar.
C. Computing fractional equivalents of decimals and checking answer with chart.
D. Checking if all safety standards are being followed.
E. Checking the heat transfer of different grinding speeds with a contact thermometer.

MACHINING EXPERIENCES - - LEVEL II

Unit IV

Title: Machining Activities Performed on the Horizontal Milling Machine.

Objective: To develop in the individual the capability to perform the following operations on the horizontal milling machine: machining a flat surface, machining parallel surfaces, machining two perpendicular surfaces, machining a shoulder, machining an angular surface.

Manual or Manipulative Learning:

A. Laying out stock with: (square, rule or scale, surface gauge, dividers, scriber).
B. Cutting stock to length with: (hand saw, power hack saw, power b band saw).
C. Cleaning machine with rag and brush to obtain an accurate setup.
D. Mounting stock with: (parallels, angle plate, vee block, shims, step blocks).
E. Mounting cutters, spacing and bearing collars on milling machine spindle.
F. Adjusting controls to obtain proper speeds for various cutters and metals to be machined.
G. Adjusting controls to obtain proper feeds for various cutters and materials.

Verbal Learning:

Communication:

A. Reading blueprints to determine: (size and characteristics of work piece, type of operation, finish and accuracy required number of parts to be machined, and kind of material).

Measurement:

A. Measuring stock to determine size with: (rule or scale, outside micrometer, sine bar, vernier calipers).
B. Reading graduations on vertical feed.

Mathematics:

A. Applying knowledge of fractions (adding, subtracting, multiplying, dividing).

H. Aligning cutter with stock to be machined.
I. Milling a flat surface.
J. Milling parallel surfaces.
K. Milling two perpendicular surfaces.
L. Milling a shoulder.
M. Milling an angular surface.
N. Applying cutting fluids to lubricate cutting action and reduce cutting temperature.
O. Removing work from holding devices.
P. Removing burrs from work with a file or abrasive cloth.

B. Applying knowledge of decimals (adding, subtracting, multiplying, dividing).
C. Computing spindle speed and feed according to type of material being machined.
D. Determining fractional equivalents of decimals from chart.
E. Computing decimal equivalents of fractions.

Science:

A. Explaining the physical properties and the machinability of various metals.
B. Explaining heat transfer as it relates to coolants.

General Information

A. Selecting appropriate layout tools for the task.
B. Selecting appropriate hacksaw blades for the task.
C. Selecting method of mounting work: (vise, clamps, jigs and fixtures).
D. Selecting proper cutter for the specific operation (slab. helical tooth, form relieved, inserted tooth, stagger tooth).
E. Selecting from chart proper speeds and feeds for various cutters and materials.
F. Selecting direction of cut.
G. Removing and disposing of chips to keep work area clear and free from danger.
H. Practicing proper safety precautions when operating a lathe: (wearing goggles or face shield, wearing appropriate apparel, removing all tools before starting machine, making adjustments after machine has stopped, using only sharpened tools, maintaining all safety guards.
I. Selecting proper type of file.
J. Selecting proper abrasive cloth
K. Selecting proper cutting fluids for various metals.

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Testing heat generated on work piece using cutters that have different shapes.maintaining a constant depth of cut with the
B aid of a contact thermometer.
B. Checking the safety precautions practiced by other students against established standards.
C. Reading blueprints to determine characteristics of work piece and the most economical method of procedure to produce a part.
D. Checking fractional and decimal equivalents from a chart.
E. Computing proper speeds and feed for various metals.
F. Milling parallel surfaces.
G. Measuring and cutting stock to length.

Unit V

Title: Machining Activities Performed on the Vertical Milling Machine

Objective: To develop in the individual the capability to perform the following operations on the vertical milling machine: machining flat surfaces, machining par parallel surfaces, machining two perpendicular surfaces, machining a shoulder.

Manual or Manipulative Learning:

A. Laying out stock with: (square, rule or scale, surface gauge, dividers, scriber).
B. Cutting stock to length with: (hand saw, power hack saw, power band saw).
C. Cleaning machine with rag and brush to obtain an accurate setup.
D. Mounting stock with: (parallels, angle plate, vee block, shims, step blocks).
E. Mounting cutters, spacing and bearing collars on milling machine spindle.
F. Adjusting controls to obtain proper speeds for various cutters and metals to be machined.
G. Adjusting controls to obtain proper feeds for various cutters and materials.

Verbal Learning:

Communication:

A. Reading blueprints to determine: (size and characteristics of work piece, type of operation, finish and accuracy required, number of parts to be machined, and kind of material).

Measurement:

A. Measuring stock to determine size with: (rule or scale, outside micrometer, vernier caliper).
B. Reading graduations on vertical feed.

Mathematics:

A. Applying knowledge of fractions (adding, subtracting, multiplying, dividing).

H. Aligning cutter with stock to be machined.
I. Milling a flat surface.
J. Milling parallel surfaces.
K. Milling two perpendicular surfaces.
L. Milling a shoulder.
M. Applying cutting fluids to lubricate cutting action and reduce cutting temperature.
N. Removing work from holding devices.
O. Removing burrs from work with a file or abrasive cloth.

B. Applying knowledge of decimals (adding, subtracting, multiplying, dividing).
C. Computing spindle speed and feed according to type of material being machined.
D. Determining fractional equivalents of decimals from chart.
E. Computing decimal equivalents of fractions.
F.

Science:

A. Explaining the physical properties and the machinability of various metals metals.
B. Explaining heat transfer as it relates to coolants.

General Information

A. Selecting appropriate layout tools for the task.
B. Selecting appropriate hacksaw blades for the task.
C. Selecting method of mounting work: (vise, clamps, jigs and fixtures).
D. Selecting proper cutter for the specific operation.
E. Selecting from chart proper speeds and feeds for various cutters and materials.
F. Selecting direction of cut.
G. Removing and disposing of chips to keep work area clear and free from danger.
H. Practicing proper safety precautions when operating a lathe: (wearing goggles or face shield, wearing appropriate apparel, removing all tools before starting machine, making adjustments after machine has stopped, using only sharpened tools, maintaining all safety guards.
I. Selecting proper type of file.
J. Selecting proper abrasive cloth.
K. Selecting proper cutting fluids for various metals.

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Testing heat generated on work piece using cutters that have different shapes maintaining a constant depth of cut with the aid of a contact thermometer.
B. Checking the safety practiced by other students against established standards.
C. Reading blueprints to determine characteristics of work piece and the most economical method of procedure to produce a part.
D. Checking fractional and decimal equivalents from a chart.
E. Computing proper speeds and feed for various metals.
F. Milling parallel surfaces.
G. Measuring and cutting stock to length.

MACHINING EXPERIENCES --- LEVEL II

Unit VI

Title: Occupational Information Pertaining to Machining and Related Occupations.

Objective: To acquaint the individual with the opportunities in machining and related occupations.

Occupational Information

Obtaining information about:

A. The employment outlook.
B. The wage scale.
C. The types of training available.
D. The working conditions experienced in the occupation.
E. The physical and mental characteristics needed for qualification for employment.
F. The geographical location of employment.
G. The opportunities for advancement.
H. The advantages and disadvantages of the occupation.
I. The nature of the work involved in the occupation.
J. The union involvement in the occupation.
K. The means of entry into the occupation.

Suggested Student Activities

A. Writing specific information concerning opportunities in the occupations of the metal forming and fabrication cluster.
B. Visiting an office of the State Employment Service.
C. Listening to a speaker from a trade union.
D. Writing letters to correspondence and trade schools in order to determine opportunities for additional training.
E. Visiting a school for apprentices.
F. Visiting a machining industry.
G. Watching movies on machining activities.
H. Reading the Occupational Outlook Handbook.

INSTRUCTIONAL MATERIALS FOR MACHINING

TYPE	TITLE	DESCRIPTION	SOURCE
Book	Machine Shop Technology by C. A. Felker	The text covers metal machining, set-ups, theory, and processes.	Bruce Publishing Co.
Book	Machine Shop Training by S.F. Krar and J.E. St. Amand	The book covers the basic machining areas.	McGraw-Hill Book Co.
Book	Machining of Metals by R. E. Smith	A well illustrated text showing basic machine operations.	McKnight and McKnight Publishing Company
Book	Machine Shop Mathematics by Aaron Axelrod	The text covers mathematics related to basic machine shop operations.	McGraw-Hill Book Co.
Book	Machine Tool Operation Part I and II by Aaron Axelrod and Henry D. Burghardt	The books cover fundamental information concerning machining and the operation of various machines found in a machine shop.	McGraw-Hill Book Co.
Book	Machine Tool Metalworking by J. L. Feirer and E. A. Tatro	The book includes a comprehensive overview of the basic machining processes.	McGraw-Hill Book Co.

Film	Basic Machines - Drill Press	Film shows operation of the drill press, 10 min. free, B & W or color.	Ideal Pictures
Film	Basic Machines - Lathe	Film shows the operation of the lathe. 20 min. free, B & W or color.	Ideal Pictures
Film	Basic Machines - Shaper	Film shows operation of the shaper. 10 min. free, B & W or color.	Ideal Pictures
Film	Cutting Threads With Taps and Dies	Film shows how to cut threads with tap and die. 20 min. free, B & W or color	Ideal Pictures
Film	Drilling, Boring and Reaming Work Held In A Chuck	Film shows operations on a drill press. 11 min. free B & W.	United World Films, Inc.
Film	Metal Working Lathe	Film illustrates the use of the lathe 20 min. free, B & W.	South Bend Lathe
Film	The Milling Machine	Film shows functions and basic operations of the milling machine 15 min. free B & W.	United World Films, Inc.
Chart	Decimal Equivalents	Decimal and fractional parts of an inch with no. size and letter size drills. 24 X 37 free.	Lufkin Rule
Chart	How To Read Micrometers	Chart explains reading of a micrometer. 22 X 17½ free.	Lufkin Rule

LEVEL I EXPERIENCES

FIRST YEAR PROGRAM

WELDING EXPERIENCES - - LEVEL I

Unit I

Title: Arc Welding Ferrous Metals With A.C. and D.C. Welders.

Objective: To develop in the individual the capability for arc welding ferrous metals with A.C. and D.C. welders, the following joints: horizontal butt, horizontal lap, horizontal inside corner, horizontal outside corner, horizontal tee, vertical lap, butt joints on pipe stock while fixed and while rolling, and pad welding.

Manual or Manipulative Learning:

A. Laying out stock with: (square, rule or scale, combination square, center head, hermaphrodite calipers, surface gauge, dividers, trammel points, scriber, center punch).
B. Cutting stock to length with: (hand saw, power hack saw, power band saw, gas cutting torch).
C. Grinding stock to specified dimensions.
D. Grinding a bevel on heavy plate for adequate penetration.
E. Connecting electrical components on welder according to manual specifications.
F. Clamping work to obtain fit-up.

Verbal Learning:

Communication:

A. Reading blueprints to determine: (size and characteristics of work piece, type of weld required and accuracy required number of parts to be welded, and kind of material).
B. Reading equipment manual to determine equipment setup.

Measurement:

A. Measuring stock to determine length with rule or scale.
B. Checking work fit up with rule and square.
C. Checking work with fillet gage.

G. Grounding work to obtain adequate conductance.
H. Cleaning metal parts to be welded to obtain weld with necessary strength.
I. Tacking fit up assembly to minimize warpage and buckling.
J. Striking an arc to join metals together.
K. Running a bend on the weld joint according to specifications.
L. Stopping and re-starting a bead for specific weld dimensions.
M. Cleaning weld with chipping ham- and wire brush for additional welding or a finished weld.
N. Removing burrs from finished work with abrasive cloth or file.

Mathematics:

A. Applying knowledge of fractions (adding, subtracting, multiplying, dividing).

Science:

A. Explaining the physical properties and the fusibility of various metals.
B. Explaining the election theory of current flow in welding.

General Information

A. Selecting appropriate layout of tools for the task.
B. Selecting appropriate hacksaw blades for the task.
C. Selecting appropriate grinder for the task.
D. Selecting correct type of electrode for size and type of metal to be be welded.
E. Selecting proper heat for type and thickness of metal being welded.
F. Positioning work to be welded in the most advantageous position for gravitational effects on appearance of bead.
G. Applying different electrode angles in relation to type and thickness of metal being welded.
H. Identifying flux for removal with chipping hammer.
I. Selecting proper type of file for task.
J. Selecting proper abrasive cloth for task.
K. Practicing proper safety precautions: (wearing goggles or face shield, wearing appropriate apparel, maintaining equipment regularly, shielding welding area).

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Reading blueprints to determine characteristics of work piece and the steps of procedure which would be most economical.
B. Welding specific scrap metal with different electrodes and heats checking welding specifications against your results.
C. Measuring and cutting stock to length.
D. Welding joints using different thickness metals.

WELDING EXPERIENCES - - LEVEL I

Unit II

Title: Gas Welding and Braying Ferrous Metals.

Objective: To develop in the individual the capability for gas welding, braying and cutting ferrous metals including the following weld joints: horizontal butt, horizontal lap, horizontal inside corner, horizontal outside corner, horizontal tee and vertical lap joints.

Manual or Manipulative Learning:

A. Laying out stock with: (square, rule or scale, combination square, center head, hermaphrodite calipers, surface gauge, dividers, trammel points, scriber, center punch).
B. Cutting stock to length with: (hand saw, power hack saw, power band saw, gas cutting torch).
C. Grinding stock to specified dimensions.
D. Grinding a bevel on heavy plate for adequate penetration.
E. Clamping work to obtain fit-up.
F. Cleaning metal parts to be welded to obtain weld with necessary strength.
G. Attaching regulators to tanks.
H. Connecting hoses to regulators.

Verbal Learning:

Communication:

A. Reading blueprints to determine: (size and characteristics of work piece, type of weld required and accuracy required, number of parts to be welded, and kind of material.
B. Reading equipment manual to determine equipment set-up.

Measurement:

A. Measuring stock to determine length with a rule or scale.
B. Checking fit up with rule and square.

Mathematics:

A. Applying knowledge of fractions (adding, substracting, multiplying, and dividing).

I. Attaching welding tip to handle.
J. Adjusting valves for desired working pressure.
K. Lighting torch.
L. Adjusting flame for correct heat.
M. Running a bead with torch and filler rod.
N. Cleaning weld with wire brush.
O. Removing burrs from finished work with abrasive cloth or file.

Science:

A. Explaining the physical properties and the fusibility of various metals.

General Information

A. Selecting appropriate layout tools for the task.
B. Selecting appropriate hacksaw blades for the task.
C. Selecting appropriate grinder for the task.
D. Selecting appropriate wrenches for valve controls.
E. Selecting appropriate welding tips for task.
F. Selecting appropriate welding rods for the task.
G. Practicing proper safety precautions when using gas welding equipment: (wearing goggles or face shield, wearing appropriate apparel, inspecting equipment for leaks and valve regulation, maintain equipment regularly, shielding welding area, cracking cylinder valves, handling tanks with proper care, welding eliminating flash-backs and backfires, recognizing the danger of using oil with oxygen, turning off torch in proper sequence.

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Checking safety practiced by different students against established standards.
B. Practicing turning on and off the valves in proper sequence to assure that the pattern is learned.
C. Practicing welding different joints with scrap metal to develop skill in handling torch and rod.
D. Checking fit up of welding assembly before and after welding to determine accuracy

WELDING EXPERIENCES - - LEVEL I

Unit III

Title: Occupational Information Pertaining to Welding and Related Occupations.

Objective: To acquaint the individual with the opportunities in welding and related occupations.

Occupational Information

Obtaining information about:

A. The employment outlook.
B. The wage scale.
C. The types of training available.
D. The working conditions experienced in the occupation.
E. The physical and mental characteristics needed for qualification for employment.
F. The geographical location of employment.
G. The opportunities for advancement.
H. The advantages and disadvantages of the occupation.
I. The nature of the work involved in the occupation.
J. The union involvement in the occupation.
K. The means of entry into the occupation.

Suggested Student Activities

A. Writing specific information concerning opportunities in the occupations of the metal forming and fabrication cluster.
B. Visiting an office of the State Employment Service.
C. Listening to a speaker from a trade union.
D. Writing letters to correspondence and trade schools in order to determine opportunities for additional training.
E. Visiting a school for apprentices.
F. Visiting a welding industry.
G. Watching movies on welding activities.
H. Reading the Occupational Outlook Handbook.

LEVEL II EXPERIENCES

SECOND YEAR PROGRAM

WELDING EXPERIENCES - - LEVEL II

Unit I

Title: Brazing Non-ferrous Metals.

Objective: To develop in the individual the capability for brazing non-ferrous metals including the following joints: horizontal butt, horizontal lap, horizontal inside corner, horizontal outside corner, horizontal tee, vertical lap.

Manual or Manipulative Learning:

A. Laying out stock with: (square, rule or scale, combination square, center head, hermaphrodite calipers, surface gauge, dividers, trammel points, scriber, center punch).
B. Cutting stock to length with: (hand saw, power hack saw, power band saw).
C. Grinding stock to specified dimensions.
D. Grinding a bevel on heavy plate for adequate penetration.
E. Clamping work to obtain fit-up.
F. Cleaning metal parts to be welded to obtain weld with necessary strength.
G. Attaching regulators to tanks.
H. Connecting hoses to regulators.
I. Attaching welding tip to handle.

Verbal Learning:

Communication:

A. Reading blueprints to determine: (size and characteristics of work piece, type of weld required and accuracy required, number of parts to be welded and kind of material.
B. Reading equipment manual to determine equipment set-up.

Measurement:

A. Measuring stock to determine length with a rule or scale.
B. Checking fit up with rule and square.

Mathematics:

A. Applying knowledge of fractions (adding, subtracting, multiplying, dividing).

J. Adjusting valves for desired working pressure.
K. Lighting torch.
L. Adjusting flame for correct heat.
M. Running a bead with torch and filler rod.
N. Cleaning weld with wire brush.
O. Removing burrs from finished work with abrasive cloth or file.

Science:

A. Explaining the physical properties and the fusibility of various metals.

General Information

A. Selecting appropriate layout tools for the task.
B. Selecting appropriate hacksaw blades for the task.
C. Selecting appropriate grinder for the task.
D. Selecting appropriate wrenches for valve controls.
E. Selecting appropriate welding tips for task.
F. Selecting appropriate welding rods for the task.
G. Practicing proper safety precautions when using gas welding equipment: (wearing goggles or face shield, wearing appropriate apparel, inspecting equipment for leaks and valve regulation, maintain equipment regularly, shielding welding area, cracking cylinder valves, handling tanks with proper care, welding eliminating flash-backs and backfires, recognizing the danger of using oil with oxygen, turning off torch in proper sequence.

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Measuring and cutting stock to length.
B. Practicing brazing on scrap pieces different types of joints to develop skill with torch and rod.
C. Checking fit up of welding assembly before and after welding to determine accuracy.

WELDING EXPERIENCES - - LEVEL II

Unit II

Title: Inert Gas Welding Ferrous and Non-ferrous Metals.

Objective: To develop in the individual the capability for inert gas welding ferrous and non-ferrous metals including the following joints: horizontal butt, horizontal inside corner, horizontal outside corner, horizontal tee, vertical lap, butt joints on pipe stock while fixed and while rolling.

Manual or Manipulative Learning:

A. Laying out stock with: (square, rule or scale, combination square, center head, hermaphrodite calipers, surface gauge, dividers, trammel points, scriber, center punch).
B. Cutting stock to length with: (hand saw, power hack saw, power band saw, gas cutting torch).
C. Installing consumable filler wire in MIG welding equipment.
D. Checking electrical connections for tightness.
E. Setting up inert gas welding equipment according to welder manual.
F. Checking inert gas fittings for tightness.
G. Belt sanding stock to specific dimension and weld angles.

Verbal Learning:

Communication:

A. Reading blueprints to determine: (size and characteristics of work piece, type of welding required and accuracy required number of parts to be welded, and kind of material.
B. Reading equipment manual to determine equipment set-up.

Measurement:

A. Measuring stock to determine length with a rule or scale.
B. Checking fit up with rule and square.

Mathematics:

A. Applying knowledge of fractions (adding, subtracting, multiplying, dividing).

H. Clamping work to obtain fit up.
I. Cleaning metal parts to be welded to obtain maximum strength from weld.
J. Preparing tungsten electrode for type current to be used.
K. Striking an arc to begin welding process.
L. Tacking fit up to relieve stresses.
M. Running a bead on weld joint according to specifications.

Science:

A. Explaining the physical properties and the fusibility of various metals.

General Information

A. Selecting appropriate layout tools for the task.
B. Selecting appropriate hacksaw blades for task.
C. Selecting correct type of electrode for task.
D. Selecting type current to be used according to metal being welded.
E. Recognizing various sizes and type of welding tips.
F. Positioning work to be welded in the most advantageous position for gravitational effects on the appearance of the bead.
G. Applying different angles in relation to type and thickness of metal.
H. Standing in proper relation to work to be welded.
I. Selecting appropriate file for task.
J. Selecting appropriate abrasive cloth for task.
K. Practicing proper safety precautions when using inert gas welding equipment: (wearing goggles or face shield, wearing appropriate apparel, maintaining equipment regularly, shield welding area).

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Welding standard size strips of same type ferrous metals using differend welding processes and testing the strength of each process used.
B. Measuring and cutting stock to length.

WELDING EXPERIENCES - - LEVEL II

Unit III

Title: Occupational Information Pertaining to Welding and Related Occupations.

Objective: To acquaint the individual with the opportunities in welding and related occupations.

Occupational Information

Obtaining information about:

A. The employment outlook.
B. The wage scale.
C. The types of training available.
D. The working conditions experienced in the occupation.
E. The physical and mental characteristics needed for qualification for employment.
F. The geographical location of employment.
G. The opportunities for advancement.
H. The advantages and disadvantages of the occupation.
I. The nature of the work involved in the occupation.
J. The union involvement in the occupation.
K. The means of entry into the occupation.

Suggested Student Activities

A. Writing specific information concerning opportunities in the occupations of the metal forming and fabrication cluster.
B. Visiting an office of the State Employment Service.
C. Listening to a speaker from a trade union.
D. Writing letters to correspondence and trade schools in order to determine opportunities for additional training.
E. Visiting a school for apprentices.
F. Visiting a welding industry.
G. Watching movies on welding activities.
H. Reading the Occupational Outlook Handbook.

INSTRUCTIONAL MATERIALS FOR WELDING

TYPE	TITLE	DESCTIPTION	SOURCE
Book	Modern Welding by Andrew A. Althouse, Carl H. Turnquist and William A. Bowditch	A well illustrated text covering practically all the modern welding practices	Goodheart-Willcox Co.
Book	Welding Skills and Practices by J.W. Giachino, Willeam Weeks and Elmer Brune	A basic text on many of the modern welding practices	American Technical Society
Book	New Lessons in Arc Welding by Lincoln Electric Company	The text covers the area of arc-welding using an up-to date approach.	Lincoln Electric Co.
Film	Aluminum Welding Is Different	Film shows that aluminum is easy to join by welding, brazing or soldering. 33 min. free, color.	Reynolds Metals Co.
Film	Arc Welding	Film shows metal-arc, carbon-arc and atomic-hydrogen processes for welding aluminum. 10 min. free, color.	Aluminum Company of America
Film	Consumable Insert Welding	Film shows a special E-B weld insert to join pipe on one side only. 20 min. free, B & W.	Arcos Corporation

Film	Introduction to Oxy-Acetylene Welding	Film shows tools and equipment, obtaining correct flame, manipulation and running beads. 2 reels, $78.00, B & W.	Jam Handy
Film	Modern Methods of Joining Metals	Film explains how gas shielded and magnetic flux methods are used in industry. 22 min. $100.00, color.	Linde Company
Pamphlet	Arc Welding	A pocket manual on how arc welding is used in industry. Purchase.	Industrial Book Co.
Pamphlet	Fusion Facts	Phamphlet gives facts on how welding can increase the life of metals.	Stoody Company
Pamphlet	Welding and Oxygen Cutters	Occupational Outlook Handbook, Bulletin No. 1215-65. Purchase.	U.S. Department of Labor

LEVEL I EXPERIENCES

FIRST YEAR PROGRAM

SHEET METAL WORKING EXPERIENCES - - LEVEL I

Unit I

Title: Cutting Sheet Metal With Hand Tools

Objective: To develop in the individual the capability in cutting sheet metal with hand cutting snips and shears in producing: straight cuts, circular cuts, irregular cuts, notched cuts and interior cuts.

Manual or Manipulative Learning:

A. Laying out stock with: (square, rule or scale, dividers, trammel points, scriber, center punch).
B. Tracing sheet metal patterns for cutting, forming and joining.
C. Adjusting pivot screw on hand shears for proper clearance.
D. Aligning sheet metal with shear blade for an accurate cut.
E. Cutting sheet metal with aviation snips (right or left hand).
F. Cutting sheet metal (24 gauge or thinner) with comination snips.
G. Cutting sheet metal with straight snips.
H. Cutting sheet metal with compound shears.
I. Cutting sheet metal (24 gauge or thinner) with bulldog snips.
J. Cutting sheet metal pipe with double cutting shears.
K. Removing burrs from sheet metal with a file or abrasive cloth.

Verbal Learning:

Communication:

A. Reading blueprints to determine: (size and characteristics of the work piece, type of operation, finish and accuracy required, kind of material.

Measurement:

A. Checking overall length of the sheet metal with a rule or scale.
B. Checking the gauge of the sheet metal with a gauge or micrometer.

Mathematics:

A. Applying knowledge of fractions (adding, subtracting multiplying, and dividing).
B. Applying knowledge of decimals (adding, subtracting, multiplying, and dividing).

General Information

A. Selecting appropriate layout tools for the task.
B. Selecting appropriate hand cutting tool for the task.
C. Selecting appropriate abrasive cloth for the task.
D. Selecting appropriate file for the task.
E. Wearing gloves when handling sharp sheet metal.

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Measuring and cutting stock to layout length.
B. Measuring the thickness of specified gauge sheet metal with a micrometer and check the reading against established standards.
C. Reading blueprints to determine characteristics of part to be made listing steps of procedure which would be most economical.
D. Practice on scrap sheet metal using the various snips comparing the results of their intended use with the problems encountered when using them incorrectly.
E. Demonstrating on a soft material what sharp sheet metal could to to your skin.

SHEET METAL WORKING EXPERIENCES - - LEVEL I

Unit II

Title: Forming Sheet Metal on Sheet Metal Forming Machines

Objective: To develop in the individual the capability in forming sheet metal on the following sheet metal forming machines: slip roll forming machine, crimping machine, beading machine, bar folder, brake.

Manual or Manipulative Learning:

A. Adjusting bottom roll for receiving specific gauge sheet metal.
B. Adjusting back roller for forming cylinder.
C. Operating slip roll forming machine to produce a cylinder.
D. Readjusting back roller for small cylinder shape.
E. Removing cylinderical shape from slip roll forming machine.
F. Installing crimping rolls on crimping machine.
G. Adjusting gage on crimping machine to produce a specific length crimp.
H. Operating a crimping machine to produce a crimped edge.
I. Adjusting crankscrew for specific depth of crimp.
J. Adjusting wing nuts for light or heavy bead when using beading and crimping rolls.

Verbal Learning:

Measurement:

A. Measuring with rule to set gage or crimping machine.
B. Measuring with rule to set gage on beading machine.
C. Reading scale adjustment on bar folder for a specific depth of bend.

Mathematics:

A. Applying knowledge of fractions: (adding, subtracting, multiplying, dividing).

K. Holding work in a horizontal position against gage.
L. Installing beading rolls on beading machine.
M. Checking alignment of the rolls for equal side clearance.
N. Adjusting gage on beading machine to set distance for bead.
O. Holding work against gage for uniform bead.
P. Operating a beading machine to produce a bead.
Q. Adjusting depth gage on bar folder for specific size hem.
R. Operating bar folder to produce a single hem and a double hem.
S. Aligning layout line with bending lead on a brake.
T. Operating a brake to produce a single hem and double hem.
U. Setting down hem on a bar folder.
V. Setting down hem on a brake.
W. Operating a bar folder to produce a single seam and a double seam.
X. Operating a brake to produce a single seam and a double seam.
Y. Readjusting depth gage on bar folder for specific size double hem.

General Information

A. Operating crimping machine without running over the seam.
B. Selecting proper beading rolls for the task called for on the blueprint.
C. Operating beading machine without running over the seam.
D. Allowing enough material for bending on brake or bar folder.

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Selecting and forming an object which will incorporate forming processes on the slip roll forming machine, crimping machine,' beading machine, bar folder and brake.
B. Determining the material needed in a particular item using a knowledge of fractions.
C. Checking accuracy of scale adjustment on bar folder by forming a hem on the brake and the bar folder and comparing the results.
D. Forming different type of sheet metal and compare the results of each type.

SHEET METAL WORKING EXPERIENCES - - LEVEL I

Unit III

Title: Joining Sheet Metal Parts

Objective: To develop in the individual the capability in joining sheet metal parts by the following methods: soldering, sheet metal screws, rivets, seams.

Manual or Manipulative Learning:

A. Cleaning surfaces to be soldered.
B. Clamping work to be soldered.
C. Tinning the solderning copper for efficient soldering practice.
D. Applying flux to the metal to be soldered.
E. Soldering sheet metal.
F. Testing soldered joints with water for leaks.
G. Drilling correct size holes to accommodate screws or rivets.
H. Punching sheet metal with a center punch to start drill.
I. Fastening sheet metal parts with sheet metal screws.
J. Riveting sheet metal parts for assembly.
K. Assembling sheet metal parts using formed seams.
L. Locking sheet metal parts for permanent assembly.

Verbal Learning:

Communication:

A. Reading blueprints to determine: (number of parts to be joined, surfaces to be soldered, size and number of sheet metal screws, parts to be riveted, size of rivets, type of rivet, style head to be formed, specific seams to be used, and their relationship).

General Information

A. Selecting appropriate method of soldering for the task.
B. Selecting method of applying solder to the specific joint.
C. Selecting appropriate solder for the job.
D. Selecting appropriate flux for the job (if needed).
E. Selecting tinning solution.
F. Selecting appropriate method of holding work to be soldered.
G. Handling acids with care for safety.
H. Selecting correct sheet metal screws for type and thickness of metal to be assembled.
I. Selecting correct tightening tools for screws to be used.
J. Selecting correct riveting tools for the job: (hand or power).
K. Selecting correct rivets to be used for type and thickness of metal to be used.
L. Selecting parts to be mated by seams.

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Testing the effectiveness of various metal cleaning solutions on standard size strips of metal to be soldered.
B. Reading blueprints to determine characteristics of parts to be made, listing the steps of procedure necessary to produce the parts.
C. Testing the strength of different joining methods on standard test pieces.
D. Practicing soldering on scrap pieces to develop skill with the copper.

Unit IV

Title: Occupational Information Pertaining to Sheet Metal Work and Related Occupations.

Objective: To acquaint the individual with the opportunities in sheet metal work and related occupations.

Occupational Information

Obtaining information about:

A. The employment outlook.
B. The wage scale.
C. The types of training available.
D. The working conditions experienced in the occupation.
E. The physical and mental characteristics needed for qualification for employment.
F. The geographical location of employment.
G. The opportunities for advancement.
H. The advantages and disadvantages of the occupation.
I. The nature of the work involved in the occupation.
J. The union involvement in the occupation.
K. The means of entry into the occupation.

Suggested Student Activities

A. Writing specific information concerning opportunities in the occupations of the metal forming and fabrication cluster.
B. Visiting an office of the State Employment Service.
C. Listening to a speaker from a trade union.
D. Writing letters to correspondence and trade schools in order to determine opportunities for additional training.
E. Visiting a school for apprentices.
F. Visiting a sheet metal industry.
G. Watching movies of sheet metal activities.
H. Reading the Occupational Outlook Handbook.

LEVEL II EXPERIENCES

SECOND YEAR PROGRAM

SHEET METAL WORKING EXPERIENCES - - LEVEL II

Unit I

Title: Cutting Sheet Metal With Machinery and Power Tools

Objective: To develop in the individual the capability in cutting sheet metal with machinery and power tools in producing: straight cuts, circular cuts, notched cuts and irregular cuts.

Manual or Manipulative Learning:

A. Laying out stock with: (square, rule or scale, dividers, trammel points, scriber, center punch).
B. Aligning sheet metal with shear blade for an accurate cut.
C. Cutting sheet metal with treddle operated squaring shear.
D. Cutting sheet metal with power operated squaring shear.
E. Cutting sheet metal with a sabre saw.
F. Centering blank on ring and circle shear.
G. Setting lock nut on adjustment handle to produce a clean cut.
H. Adjusting upper cutter adjustment handle on ring and circle cutter for specific gauge sheet metal.
I. Cutting sheet metal with a ring and circle shear.
J. Cutting sheet metal with a bench level shear.

Verbal Learning:

Communication:

A. Reading blueprints to determine: (size and characteristics of the work piece, type of operation, finish and accuracy required, kind of material.

Measurement:

A. Checking overall length of the sheet metal with a rule or scale.
B. Checking the gauge of the sheet metal with a gauge or micrometer.
C. Reading graduations on sheet metal machinery to determine specific dimensions.
D. Checking measurement of required circle on graduations on bed scale.

K. Adjusting blades or notches for desired notched style.
L. Cutting sheet metal with a portable power shear.
M. Cutting sheet metal with a combination notches, coper and shear.
N. Cutting sheet metal with a sabre saw.
O. Cutting sheet metal with a nibbler.
P. Removing burrs from sheet metal with a file or abrasive cloth.

Mathematics:

A. Applying knowledge of fractions (adding, substracting, multiplying, and dividing).
B. Applying knowledge of decimals (adding, substracting, multiplying, and dividing).

General Information

A. Selecting appropriate layout tools for the task.
B. Selecting appropriate machine or power tool for the task.
C. Selecting appropriate abrasive cloth for the task.
D. Selecting appropriate file for the task.
E. Wearing gloves when handling sharp sheet metal.

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Measuring and cutting stock to layout length.
B. Cutting sheet metal with various machines comparing ease of alignment, accuracy of cut, and type of finished edge is produced.
C. Checking the accuracy of scale on the bed of the ring and circle shear by cutting a circle using the bed scale and then cutting one which has been scribed with a divider.
D. Reading blueprints to determine characteristics of part and listing in the order of their use the machines and tools that will be needed to produce the part.
E. Using fractions, determine the area in square inches of a part to be made.

SHEET METAL WORKING EXPERIENCES -- LEVEL II

Unit II

Title: Forming Sheet Metal on Sheet Metal Forming Machines

Objective: To develop in the individual the capability in forming sheet metal on the following sheet metal forming machines: Pittsburgh lock-seam former and the drive cap machine.

Manual or Manipulative Learning:

A. Adjusting drive cap machine for specific gage sheet metal to be fed.
B. Cutting sheet metal to specific dimensions for feeding drive cap machine.
C. Operating a drive cap machine.
D. Adjusting Pittsburgh back-seam former for specific gage sheet metal to be fed.
E. Operating the Pittsburgh lock-seam former.

Verbal Learning:

Mathematics:

A. Determining overall dimensions of piece to be formed by adding material to form lock plus width of piece.

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Forming the Pittsburgh lock seam using different gauges of sheet metal.
B. Reading blueprints to determine the over-all length of a piece needed to make a Pittsbrugh lock seam.

SHEET METAL WORKING EXPERIENCES - - LEVEL II

Unit III

Title: Joining Sheet Metal Parts

Objective: To develop in the individual the capability in joining sheet metal parts by the following methods: adhesives, spot welding and bolts.

Manual or Manipulative Learning:

A. Cleaning surfaces to be bonded with appropriate cleaning solution, (adhesives and spot welded).
B. Mixing adhesive compound according to procedure called for in specifications of adhesive.
C. Applying adhesive to area to be bonded according to specifications of adhesive.
D. Clamping metal bonded assembly in a manner appropriate to assembly and specifications of adhesives.
E. Removing clamping devices from bonded assembly.

Verbal Learning:

Communication:

A. Reading blueprints to determine: (adhesive to be used, surfaces to be bonded, number and spacing of spot welds, parts to be bolted, size of bolts, fit, torque).

Measurement:

A. Calculating proportions of components of adhesive according to adhesive specifications.
B. Measuring with scale and marking pencil, spots to be welded.

Mathematics:

A. Applying knowledge of weight and volume for mixing adhesives.
B. Applying knowledge of decimals: (adding, subtracting, multiplying, and dividing).

General Information

A. Selecting adhesives to be used for the sheet metal assembly.
B. Selecting the correct amperage for metal thickness to be welded.
C. Selecting the correct tips for specific weld requirements.
D. Selecting the correct time-pressure for metal thickness to be welded from a chart.
E. Selecting the spot welder most appropriate for the task.
F. Selecting the correct bolts for type and thickness of metal to be assembled.
G. Selecting the correct tightening tools for the bolts to be used.
H. Selecting the correct washers to be used for assembly.

Suggested Student Activities

A. Testing the effectiveness of various metal cleaning solutions by applying a specific adhesive to standard size metal strips and checking the amount of pressure needed to pull them apart.
B. Applying adhesives with various types of applicators and testing there strength.
C. Reading a blueprint to determine characteristics of a part and the joining process specified, discussing the advantages and disadvantages of the process and if it is the best method.

SHEET METAL WORKING EXPERIENCES - - LEVEL II

Unit IV

__Title__: Occupational Information Pertaining to Sheet Metal Work and Related Occupations.

__Objective__: To acquaint the individual with the opportunities in sheet metal work and related occupations.

__Occupational Information__

Obtaining information about:

A. The employment outlook.
B. The wage scale.
C. The types of training available.
D. The working conditions experienced in the occupation.
E. The physical and mental characteristics needed for qualification for employment.
F. The geographical location of employment.
G. The opportunities for advancement.
H. The advantages and disadvantages of the occupation.
I. The nature of the work involved in the occupation.
J. The union involvement in the occupation.
K. The means of entry into the occupation.

Suggested Student Activities

A. Writing specific information concerning opportunities in the occupations of the metal forming and fabrication cluster.
B. Visiting an office of the State Employment Service.
C. Listening to a speaker from a trade union.
D. Writing letters to correspondence and trade schools in order to determine opportunities for additional training.
E. Visiting a school for apprentices.
F. Visiting a sheet metal industry.
G. Watching movies of sheet metal activities.
H. Reading the Occupational Outlook Handbook.

INSTRUCTIONAL MATERIALS FOR SHEET METAL

TYPE	TITLE	DESCRIPTION	SOURCE
Book	Sheet Metal Drafting by Melvin L. Betterley	The text covers sheet metal layout	McGraw-Hill Book Co.
Book	Sheet Metal Shop Practice by Leroy F. Bruce and Leo A. Meyer	A comprehensive text of modern sheet metal practices	American Technical Society
Book	Sheet Metal Practice by William Neundorf and Claude Stevens	The text covers basic operations and practices of the sheet metal worker	McGraw-Hill Book Co.
Film	Hand Soldering	Film covers theory, preparation and process. 20 min. B & W.	United World Films
Film	How to Rivet Aluminum	Film covers manufacturing of rivets and explains complete process of riveting. 27 min. B & W.	U.S. Bureau of Mines
Film	Inspection of Sheet Metal Parts	Film shows how to make visual and spot checks of sheet metal parts. 20 min. B & W.	Arizona State University United World Film, Government
Film	Sheet Metal Worker	Film is 16mm, sound, B & W or color, 10 min.	Ideal Pictures
Film	The Sheet Metal Worker	Film covers operation of a sheet metal shop. 11 min. B & W.	Carl F. Mahnke Productions

Chart	Aluminum High School Chart	Chart shows production of aluminum. Free.	Aluminum Company of America
Pamphlet	Riveting Aluminum, No. F-7a	A reprint from "Modern Metals". 8 pages.	Reynolds Metals Co.

LEVEL I EXPERIENCES

FIRST YEAR PROGRAM

ASSEMBLY EXPERIENCES - - LEVEL I

Unit I

Title: Cutting Materials With Hand Tools.

Objective: To develop in the individual the capability for cutting materials with hand tools.

Manual or Manipulative Learning:

- A. Laying out stock with: (square, rule or scale combination square, center head, hermaphrodite calipers, dividers, trammel points, scriber, center punch).
- B. Cutting materials with diagonal cutting pliers.
- C. Cutting balls, rods, and heavy wire with bolt cutter.
- D. Cutting materials with side cutting pliers.
- E. Cutting metal tubing with tubing cutter.
- F. Cutting materials with combination pliers.
- G. Cutting materials with hacksaws.
- H. Cutting materials with sheet metal snips (all types)
- I. Mounting drill bit in hand drill and power hand drill.
- J. Drilling material with hand drill and with power hand drill.

Verbal Learning:

Communication:

- A. Reading blueprints to determine: (size and characteristics of work piece, type of operation, finish and accuracy required number of parts, and kind of material).

Mathematics:

- A. Applying knowledge of fractions: (adding, subtracting, multiplying and dividing).
- B. Applying knowledge of decimals: (adding, subtracting, multiplying and dividing).

General Information

A. Selecting appropriate cutting tool for the task.
B. Practicing keeping hands clear of cutting area.
C. Cutting metals with sharp tools only.
D. Selecting hand drill or power drill appropriate for the task.
E. Selecting drill bit size according to the working drawing.
F. Practicing keeping hands clear from drilling area.
G. Selecting reamer wrench appropriate for the task.
H. Selecting correct size reamer appropriate for the task.
I. Selecting proper countersink for the task.
J. Using punches which have had heads ground to safety specifications.

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Measuring and cutting stock to length.
B. Reading blueprints to determine characteristics of parts to be assembled and the most economical procedure to follow.
C. Cutting materials with various types of cutting tools to determine which is most satisfactory.

ASSEMBLY EXPERIENCES - - LEVEL I

Unit II

Title: Joining Parts of An Assembly.

Objective: To develop in the individual the capability of joining parts with screws, bolts, and rivets.

Manual or Manipulative Learning:

A. Tightening screws with: (allen wrench, phillips head screwdriver, standard screwdriver, offset screwdriver).
B. Tightening bolts with: (adjustable wrench, torque wrench, socket wrench (offset), socket wrench (T-handle), allen wrench, socket wrench rachet (ratchet), open-end wrenches, box-end
C. Riveting metal parts with power tools to produce an assembly.
D. Punching rivets in an assembly with a drift punch.
E. Riveting metal parts with hand tools to produce an assembly.

Verbal Learning:

Communication:

A. Reading blueprints to determine: (size and number of screws to be used, size and number of bolts to be used, and size and number of rivets to be used).

General Information

A. Selecting correct screws to be used for type and thickness of metal parts to be assembled.
B. Selecting correct tools to be used for assemblying with screws.
C. Selecting bolts to be fastened to different types and thicknesses of metal parts.
D. Selecting correct tools to be used for assemblying with bolts.
E. Selecting correct rivets to be used for type and thickness of metal parts to be assembled.
F. Selecting correct riveting tools to be used for the job.

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A.. Practicing using the screw tightening tools in a number of different situations determining which tool is most suited for the job.
B. Reading blueprints to determine relationship of parts and fasteners used discussing the advantages and disadvantages of the specified fastener.
C. Disassembling and re-assembling an item which uses screws, bolts, and rivets as fastening devices.

ASSEMBLY EXPERIENCES - - LEVEL I

Unit III

Title: Measuring and Checking Dimensions of Parts With Precision and Non-Precision Instruments

Objective: To develop in the individual the capability in using precision and non-precision instruments when measuring and checking dimensions.

Manual or Manipulative Learning:+

A. Checking squareness of objects with a try square.
B. Checking squareness of objects with a carpenter's square.
C. Measuring and checking dimensions with: (tap rule, steel rule, steel tap, folding top, hook rule).
D. Checking dimensions with dividers.
E. Checking dimensions with a combination square.
F. Checking gage of sheet metal or wire with a wire gage.
G. Measuring and checking dimensions with: (outside and inside calipers, outside micrometer).

Verbal Learning:

Communication:

A. Reading blueprints to determine: (size of the workpiece, finish and accuracy required).

Mathematics:

A. Applying a knowledge of fractions (adding, subtracting, multiplying and dividing).
B. Applying a knowledge of decimals (adding, subtracting, multiplying and dividing).
C. Calculating unknown dimensions from known dimensions to check for accuracy.

General Information

A. Selecting appropriate instrument for the task.
B. Practicing safe instrument handling for accurate measurement.

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Checking dimensions with different instruments to determine accuracy.
B. Measuring precision standard blocks with different instruments to verify accuracy.
C. Reading blueprints checking the accuracy of the dimensions.

ASSEMBLY EXPERIENCES - - LEVEL I

Unit IV

Title: Aligning Parts, Clamping and Mounting Work and Filing Parts.

Objective: To develop in the individual the capability to align parts, clamp and mount work and file parts.

Manual or Manipulative Learning:

A. Aligning parts with an alignment punch.
B. Clamping and holding round stock in a pipe vise.
C. Clamping and holding in a (machinist's vise, swivel vise, C-clamps).
D. Installing sub-assemblies in jigs and fixtures for assembly.
E. Filing materials with different shaped files to remove excess metals including deburring.

Verbal Learning:

Communication:

A. Reading blueprints to determine relationship of parts.

General Information

A. Selecting correct tool for aligning parts.
B. Clamping work to appropriate tightness dependent upon the material and operation to be performed.
C. Selecting appropriate mounting or clamping device for specific operation to be performed.
D. Selecting appropriate file for the task.

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Filing on a scrap part with different cuts of files to determine the type of finish each will produce.
B. Mounting various shaped items in holding devices discussing the advantages of each type.
C. Aligning different parts with punches.

ASSEMBLING EXPERIENCES - - LEVEL I

Unit V

Title: Occupational Information Pertaining to Assembling and Related Occupations.

Objective: To acquaint the individual with the opportunities in assembling and related occupations.

Occupational Information

Obtaining information about:

A. The employment outlook.
B. The wage scale.
C. The types of training available.
D. The working conditions experienced in the occupation.
E. The physical and mental characteristics needed for qualification for employment.
F. The geographical location of employment.
G. The opportunities for advancement.
H. The advantages and disadvantages of the occupation.
I. The nature of the work involved in the occupation.
J. The union involvement in the occupation.
K. The means of entry into the occupation.

Suggested Student Activities

A. Writing specific information concerning opportunities in the occupations of the metal forming and fabrication cluster.
B. Visiting an office of the State Employment Service.
C. Listening to a speaker from a trade union.
D. Writing letters to correspondence and trade schools in order to determine opportunities for additional training.
E. Visiting a school for apprentices.
F. Visiting an industry which has assembly work as part of it's functions.
G. Watching movies of assembling activities.
H. Reading the Occupational Outlook Handbook.

LEVEL II EXPERIENCES

SECOND YEAR PROGRAM

ASSEMBLY EXPERIENCES - - LEVEL II

Unit I

Title: Cutting Materials With Hand and Power Tools

Objective: To develop in the individual the capability of cutting materials with hand and power tools.

Manual or Manipulative Learning:

A. Laying out stock with: (square, rule or scale, combination square, dividers, trammel points, scriber, center punch).
B. Cutting materials with various types of chisels.
C. Mounting tap in tap wrench.
D. Applying cutting oil to tapping and die cutting operations.
E. Tapping a hole with a tap to produce a threaded hole.
F. Removing tap from finished hole.
G. Cutting stock with a die to produce external threads.
H. Removing die from finished external thread.
I. Cutting materials with a sabre saw.
J. Cutting material with a nibbler.
K. Cutting material with a hand hack saw.

Verbal Learning:

Communication:

A. Reading blueprints to determine: (size and characteristics of work piece, type of operation, finish and accuracy required number of parts to be machined, and kind of material.

Mathematics:

A. Applying knowledge of fractions (adding, subtracting, multiplying, dividing).
B. Applying knowledge of decimals (adding, subtracting, multiplying, dividing).

General Information

A. Practicing keeping hands away from cutting area.
B. Cutting metals with sharp tools only.
C. Selecting appropriate tap wrench for the task.
D. Selecting appropriate tap for the task.
E. Tapping hole according to type of material.
F. Selecting appropriate die wrench for the task.
G. Selecting appropriate die for the task.
H. Cutting external threads according to type of material.
I. Selecting appropriate layout tools for the task.
J. Selecting appropriate power cutting tool for the task.

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Laying out stock to specifications.
B. Reading blueprints to determine the size and characteristics of a work piece.

ASSEMBLY EXPERIENCES - - LEVEL II

Unit II

Title: Forming Materials With Hand Tools.

Objective: To develop in the individual the capability to perform the following forming operations: flaring tubing with a flaring tool, hammering materialslfor forming and positioning, and stamping materials with stamping tools.

Manual or Manipulative Learning:

A. Mounting tubing in tubing flaring tool.
B. Flaring metal tubing with a tubing flaring tool.
C. Hammering appropriate materials with: (ball peen hammer, straight peen hammer, cross peen hammer, soft face hammer, wooden mallet).
D. Laying out stock with a: (square, rule or square, combination square, dividers, trammel points, scriber).
E. Aligning stamping tools with layout line.
F. Stamping numbers and/or letters on metal parts for identification.

Verbal Learning:

Communication:

A. Reading blueprints to determine style and size of numbers and/or letters to be used for stamping.

Mathematics:

A. Applying a knowledge of fractions: (adding, subtracting, multiplying, and dividing).

General Information

A. Checking to see if burrs have been removed from tubing.
B. Checking to see if tubing has been cut squarely.
C. Selecting appropriate flaring tool for the task.
D. Selecting appropriate hammer for the task.
E. Recognizing the necessity of using hammers with head tight to handle.
F. Selecting number and/or letters to be used.

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Flaring metal tubing to specific dimensions.
B. Practicing stamping operations on a scrap piece to develop skill in the use of stamps.
C. Reading a blueprint to determine the characteristics of a part.

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ASSEMBLY EXPERIENCES - - LEVEL II

Unit III

Title: Joining Parts in Assembly.

Objective: To develop in the individual the capability in joining parts in assembly by the following means: with adhesives and by mating complimentary parts.

Manual or Manipulative Learning:

A. Cleaning surfaces to be bonded with appropriate cleaning method: (chemical or acid bath, abrasive).
B. Setting up metal assembly for bonding.
C. Mixing adhesive compound according to procedure called for in specifications of the adhesive.
D. Filling spray chamber with adhesive.
E. Adjusting spray gun for proper spray density.
F. Spraying metal surfaces with adhesive spray gun to produce a metal bonded assembly.
G. Cleaning spray chamber with appropriate thinner.
H. Applying adhesive to area to be bonded with hand tools.
I. Clamping metal bonded assembly in a manner appropriate to the assembly and specifications of adhesive.

Verbal Learning:

Communication:

A. Reading blueprints to determine (adhesive to be used, surface to be bonded, exploded view drawing--the relationship of detail parts to be mated).

Measurement:

A. Calculating proportions of components of adhesive according to specifications.

Mathematics:

A. Applying knowledge of weight and volume for mixing adhesives.

J. Cleaning hand tools used in applying the adhesive.
K. Removing clamping devices from bonded assembly.
L. Aligning mated parts for assembly with an aligning punch.
M. Mating parts to produce a sub-assembly.

General Information

A. Selecting appropriate hand tools or spray equipment for adhesive application.
B. Selecting appropriate adhesive to be used for the metal bonded assembly according to blueprints.
C. Selecting appropriate clamping devices for assembly.
D. Selecting appropriate mixing equipment for adhesive.
E. Practicing proper safety precautions as indicated on the specifications of adhesive.
F. Selecting mated parts for the sub-assembly.

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Testing different adhesives on standard size strips of metal for their shear strength.
B. Testing the effectiveness of different cleaning solutions using an adhesive on test strips.
C. Reading blueprints to determine parts relationships.

ASSEMBLY EXPERIENCES - - LEVEL II

Unit IV

Title: Measuring and Checking Dimensions With Precision Instruments.

Objective: To develop in the individual the capability in using precision instruments when measuring and checking dimensions.

Manual or Manipulative Learning:

A. Measuring and checking dimensions with: (sliding T-bevel, micrometer, inside, outside depth, screw thread, feeler gage).
B. Determining number of threads per inch with a thread gage.

Verbal Learning:

Communication:

A. Reading blueprints to determine: (size of the work piece, finish and accuracy required).

Mathematics:

A. Applying a knowledge of fractions (adding, subtracting, multiplying and dividing).
B. Applying a knowledge of decimals (adding, subtracting, multiplying and dividing).
C. Calculating unknown dimensions for known dimensions to check for accuracy.

General Information

A. Selecting appropriate instrument for the task.
B. Practicing safe instrument handling for accurate measurement.

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Practicing reading the different micrometers and checking the inside micrometer against the outside micrometer at different readings.
B. Checking the number of threads per inch on various size threaded items.
C. Reading blueprints to determine how threaded members are identified.
D. Calculating unknown dimensions from blueprints and checking the dimension with the part.

ASSEMBLING EXPERIENCES - - LEVEL II

Unit V

Title: Occupational Information Pertaining to Assembling and Related Occupations.

Objective: To acquaint the individual with the opportunities in assembling and related occupations.

Occupational Information

Obtaining information about:

A. The employment outlook.
B. The wage scale.
C. The types of training available.
D. The working conditions experienced in the occupation.
E. The physical and mental characteristics needed for qualification for employment.
F. The geographical location of employment.
G. The opportunities for advancement.
H. The advantages and disadvantages of the occupation.
I. The nature of the work involved in the occupation.
J. The union involvement in the occupation.
K. The means of entry into the occupation.

Suggested Student Activities

A. Writing specific information concerning opportunities in the occupations of the metal forming and fabrication cluster.
B. Visiting an office of the State Employment Service.
C. Listening to a speaker from a trade union.
D. Writing letters to correspondence and trade schools in order to determine opportunities for additional training.
E. Visiting a school for apprentices.
F. Visiting an industry which has assembly work as part of it's functions.
G. Watching movies of assembling activities.
H. Reading the Occupational Outlook Handbook.

INSTRUCTIONAL MATERIALS FOR ASSMEBLY

TYPE	TITLE	DESCRIPTION	SOURCE
Book	Basic Hand Tools by U.S. Bureau of Naval Personnel	Book covers basic hand and small power tools.	Government Printing Office
Book	Mechanical Fastening Methods For Aluminum	Handbook describes methods of fastening aluminum.	Reynolds Metals Co.
Film	Care And Use of Hand Tools: Part I: An Introduction To Hand Tools	Films show the general principles and rules for using hand tools properly. 11 min. free, B & W.	United World Films, Inc.
	Part II: Basic Layout Tools	7 min. free, B & W.	United World Films, Inc.
	Part III: Hacksaws	5 min. free, B & W.	United World Films, Inc.
	Part IV: Files & Filing	5 min. free, B & W.	United World Films, Inc.
	Part V: Twist Drills	7 min. free, B & W.	United World Films, Inc.
	Part VI: Metal Cutting Chisels	5 min. free, B & W.	United World Films, Inc.
	Part VII: Threading With Taps & Dies	5 min. free, B & W.	United World Films, Inc.
Film	The Tools And Rules For Precision Measuring	Film shows the highlights in the history of precision measuring	Aluminum Company of America

Chart	Lathe Wall Chart	Chart shows parts of a lathe 4 ft. by 6 ft. free.	LeBlond Machine Tool Company
Phamphlet	Tools and Rules For Precision Measuring	Phamphlet describes methods of using precision tools correctly. free.	L. S. Starrett Co.

SOURCES FOR INSTRUCTIONAL MATERIALS

This section of the report provides the addresses for the instructional materials listed at the end of each occupational area.

SOURCES FOR INSTRUCTIONAL MATERIALS

Aluminum Company of America
1717 Gulf Building
Pittsburgh, Pennsylvania

American Technical Society
Department W. 292
848 E. 58th St.
Chicago 37, Illinois

Arcos Corporation
1500 S. 50th St.
Philadelphia 43, Pennsylvania

Arizona State University
Film Cooperative
Tempe, Arizona

The Bruce Publishing Co.
400 N. Broadway
Milwaukee 1, Wisconsin

Bureau of Mines, U.S.
Central Experimental Station
4800 Forbes St.
Pittsburgh 13, Pennsylvania

Carl F. Mahnke Productions
215 E. 3rd St.
Des Moines, Iowa

Cincinnati Tool Company
Wauerly & Main
Cincinnati 12, Ohio

Cleveland Twist Drill Co.
1242 E. 49th St.
Cleveland 14, Ohio

Goodheart-Willcox Co., Inc.
1322 South Wabash Ave.
Chicago 5, Illinois

Ideal Pictures Corporation
28 E. 8th St.
Chicago 5, Illinois

Industrial Book Company
Cleveland 13, Ohio

Jam Handy
281 E. Grand Blvd.
Detroit 11, Michigan

Leblond Machine Tool Co.
Cincinnati 8, Ohio

Lincoln Electric Company
Department 1736, Box 3115
Cleveland 17, Ohio

Linde Company
30 E. 42nd St.
New York 17, New York

Lufkin Rule Company
Saginaw, Michigan

McGraw-Hill Book Co., Inc.
330 W. 42nd St.
New York 36, New York

McKnight & McKnight Publishing
Company
Bloomington, Illinois

Reynolds Metals Company
P.O. Box 2346
Richmond 18, Virginia

South Bend Lathe
South Bend 22, Indiana

L.S. Starrett Co.
Athol, Massachusetts

Stoody Company
Whittier, California

United World Films
1445 Park Ave.
New York 29, New York

U.S. Department of Labor
Washington 25, D.C.

U.S. Government Printing
Office
Washington 25, D.C.